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size and type, as well as diffuse processes, come to be laid down in the lungs everywhere. It is a progression of changes extending from the top to the bottom, the older ones above, the younger ones below. Newly formed processes add to the gravity of the case with almost geometrical ratio; for these too can proceed to ulceration and cavitation, and thus help to spread infection as they destroy the tissue of the lung. As the pulmonary structures are invaded non-specific pathological effects are produced: weakened bronchial walls belly out into bronchiectases; lobules shut off from their air-passages collapse into atelectasis; other lobules, with vicarious function put upon them because of overmuch lung tissue destroyed and with thinned-out walls due to undernutrition, balloon out into emphysema; pinched and obstructed bloodvessels thrombose; lymphatics suffer stasis of their flow and dilate. Meanwhile, too, the pleura undergoes every type of pathological change; inflammation of every degree, from hyperemia and congestion without effusion, to the pouring out of serous, seropurulent and even (though rare) bloody fluid, as the membrane itself becomes involved by localized or diffuse processes, with or without caseation; and, as organization of the process takes place, it leaves residua manifest as scarred pleura of varying thickness and density, and strings, bands or sheets of fibrous tissue, *adhesions*, tying the lung to the chest-wall, the mediastinum and the diaphragm. Indeed, the lung may be completely adherent. But usually it is bound most at the top and behind, with adhesions diminishing in number and strength as we proceed downward and forward. There may even be tuberculous empyema.

On occasion, also, a spot at or near the pleura may be replaced by a cavity, in the development of which the membrane has been devitalized and weakened. If now strain be put upon the pleura, from coughing, from the sudden contraction of the great muscles attached to the chest, or from any act that involves sudden or unusual closure of the glottis, then, "bombarded" by the violently raised intrapulmonary pressure, the pleura may give way, and pneumothorax result.

A lung that has for years been the seat of slowly advancing tuberculosis thus presents a most remarkable mixture and jumble of effects. It seems almost impossible that such a multiplicity and diversity of pathological changes can be the work of one and the same disease. Yet, if one remembers that four simple elements—proliferation, exudation, necrosis and repair—are at work in every significant process caused by tubercle bacilli, they will understand how the gamut of pathological change can be run; and, applying this to the distortion and destruction of organic architecture, which these changes accomplish, they will begin to comprehend what, at first sight, appears like a hodge-podge before them.

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CHAPTER VI

THE SYMPTOMS, DIAGNOSIS, PROGNOSIS, PROPHYLAXIS, AND TREATMENT OF TUBERCULOSIS

By LAWRASON BROWN, M.D.

THE SYMPTOMS OF TUBERCULOSIS

In some cases pulmonary tuberculosis is almost entirely a disease of symptoms; in others, it is true, of physical signs, but these are far in the minority. The symptoms can be grouped in two classes: first, the general, (fever, rapid pulse, loss of weight and strength, night sweats, chills, etc.), and second, the localizing symptoms (cough, sputum, hemoptysis, dyspnœa, pain in the chest). The general symptoms are often not sharply defined and may be so slight as to excape the patient's notice. They are of less importance in localizing but of more importance in determining the activity of the disease. The relative importance of the symptoms is difficult to determine, but none is of greater value to the physician than fever.

Fever.—Fever may precede all other symptoms and few patients are apyretic throughout the entire course but most minimal cases are afebrile as soon as their lives are well regulated. The fever is characterized by chronicity, post-meridian occurrence, a daily maximum usually at the same hour, occurrence in attacks which may supervene upon a normal or slightly elevated temperature and often by remarkably slight constitutional disturbance.

It is of the greatest importance to know the temperature of each patient. He should be provided with a good thermometer recently tested and taught how to take his temperature. If taken by mouth, in cold weather he should be in a warm room for ten to thirty minutes with his lips closed. If taken by rectum, it is wise not to take the temperature soon after a stool, or for one hour following exercise. Menstruation and pelvic inflammation may affect the rectal more than the oral temperature. The rectal temperature is more accurate, and reveals a rise earlier than the oral which closely approximates the rectal when the body temperature reaches 102° F.

The temperature should be taken every two hours, beginning on awakening, until the medical adviser is fully acquainted with the range. Then if the temperature be normal it may be taken on awakening, when the daily maximum occurs, and at 8 P.M. In neurotic patients as little attention as is consistent with proper treatment should be paid to the temperature. This consists, in afebrile patients, of taking the temperature for two days every two to four weeks, and during the interval if there is any suspicion of fever. If the patient cannot sleep or has

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headache he should take his temperature during the night, as in some cases the rise occurs at night only, or a second rise may occur then.

Exercise affects the rectal temperature much more than the oral. Simply getting out of bed in the morning may raise the rectal temperature some tenths of a degree, and after exercise a rectal temperature of 101° or over has been frequently recorded in apparently normal individuals. A rectal temperature of 100.4° immediately after exercise is not to be considered abnormal. The oral temperature rarely shows much elevation after exercise and may be lowered for some time on account of the cooling influence of the more rapidly respired air.

Cause of Fever.—This is primarily the effect of the changed or unchanged tuberculous protein, and of tissue disintegration products, absorbed from the tuberculous focus, upon the heat centre, rendered no doubt more irritable by previous contact with the same irritants in doses too small to cause fever. The fever produced by the injection of tuberculin proves that secondary organisms and their products are not necessarily its cause. The fever late in the disease, the hectic or absorption fever, may be due in part at least to the absorption of bacterial proteins other than those produced by the tubercle bacillus, which is still unproved, or to deficit of free water.

The temperature curve with its daily rise or rises can be readily explained by the effect of bodily exercise upon absorption. The absence of fever after the long rest at night is thus explained as well as the afternoon rise after the exertion of the morning. No doubt this explains also the rise of temperature at night in some patients with severe cough on lying down. Absorption, therefore, plays an important part, and the higher fever in acute tuberculosis or in acute attacks is due to the greater absorption through the more patent lymph channels. The disease in patients with fibroid phthisis or chronic cavity formation may be afebrile, although advancing. In other cases fever occurs only when the outlet of the cavity is plugged or when fresh areas with patent lymph channels are involved. Fever caused by overexertion may not occur for several days.

Fever in Chronic Pulmonary Tuberculosis.—Every known type of fever may occur, but the usual temperature curve is normal or slightly subnormal in the morning and rises to 99.5° or 100° F. (by mouth) between noon and 9 P.M. The fastigium lasts usually for two or three hours, but may be so short that it is recorded only when the temperature is taken every two hours. If it lasts for seven to ten hours and forms an elevated plateau with a sharp rise and fall when hourly temperatures are recorded, it is considered as surely due to tuberculosis (Woodhead, and Varrier-Jones). As a rule, the maximum is between 3 and 5 P.M., the minimum between 2 and 4 A.M. Many patients have a slight rise for months before their attention is called to it by some other symptom. As the disease advances the febrile attacks are sharper and in some instances more protracted, but the acute exacerbations of fever are often of ten to fourteen days' duration, the time which is required in experimental tuberculosis for the formation of antibodies. Such attacks may occur at intervals of one or two months. In still more advanced stages, fever is present at some time every day, and may be continuous, inter-

mittent, or, as is more usual, remittent. The temperature seldom exceeds 104°, but is frequently subnormal. A fall of temperature is often observed after the formation of a cavity. In many cases, the temperature goes from normal or slightly below to 100° or 101° F. with great regularity.

It must not be expected that the temperature curve will always follow the course just outlined, undisturbed by other causes. Complications, tuberculous and non-tuberculous, as well as an advance of the tuberculous process in the lungs, may cause fever. A sudden and sharp rise without warning rarely occurs in the ordinary progression of the disease.

The temperature of the tuberculous patient is very unstable, due in part at least to the effect of the tuberculous poison upon the nervous system, especially upon the heat-regulating centre. Slight mental excitement or slight physical exercise causes more rapid heart action and increased stimulation of the heat centre, either from increased poison in the blood or from an increased amount of poison in contact with the heat centre. However this may be, the tuberculous invalid is prone to rise of temperature from trivial causes. The rise of temperature in 50 to 60 per cent. of patients from one to seven days before or during the menstrual period and the "digestion fever" said to occur in some patients, usually anemic, after the chief meal of the day, are due, no doubt, to this lability of the temperature.

Fever, if of any duration and not due to complications, indicates activity in the pulmonary lesion. The disease, however, can progress without discoverable fever, although this takes place usually only when the individual has no longer sufficient powers of resistance. As a rule, the degree of activity can be told from the temperature chart. Even a slight rise of the minimum temperature is to be regarded as suspicious of increased tuberculous poisoning, while the maximum temperature usually shows the intensity of the disease or possibly the activity of the secondary organisms. High intermitting fever indicates a severe and deep-seated lesion and often quick destruction of tissue. Fever may occur and the patient show the signs of increased activity, but several days may elapse before any increase in the physical signs becomes evident. Some patients recover from the febrile attack before the lesion causing it is discovered. A rise to 106° or 108° F., if present at all, usually occurs shortly before death, but in the writer's experience it is much more common for the temperature to fall below normal for a day or two before death. The temperature on the two sides of the body may vary and is usually higher on the side affected.

Fever in Acute Pulmonary Tuberculosis.—In these cases fever is usually marked and may closely simulate that of typhoid fever, pneumonia, or suggest malaria. The temperature curve, however, seldom closely simulates a single tertian infection. In a few cases the rise extends over two days to become normal on the third. This may be repeated a number of times. In most cases of acute tuberculosis the temperature is continuously high, with but slight morning remissions.

In *acute miliary* tuberculosis, either primary or secondary, the temperature is usually high, continuous, with very slight morning remissions,

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and may range between 102° and 105° F. for days. Marked remissions with a normal temperature of several days' duration may occur. The "inverse" type of temperature, said to be the only curve due solely to the tuberculous poison, is rarely observed in this or other forms of pulmonary tuberculosis. In *acute pneumonic* tuberculosis the temperature curve is at times similar to that of typhoid fever in the second week, or of pneumonia, but more often it resembles typhoid in the third or fourth week, with more or less marked remissions. The temperature usually ranges from 100° or 101° to 103° or 104° F.

Fibroid tuberculosis may occur with slight or no elevation of temperature, or the temperature may be subnormal.

Some affirm, without proof, that the presence of mixed infections can be told from the temperature and that the "streptococcic" curve is characteristic. In the morning the temperature is often markedly subnormal, and Lebert records one case in which it reached 89° F. In the afternoon or evening the temperature rises rapidly to from 101° to 104° F. A variation of 4° or 5° is frequent, and 14° has been observed. Uncomplicated serous membrane tuberculosis may produce a hectic fever.

Weight.—Loss and Gain.—Wasting is most characteristic of pulmonary tuberculosis, termed for this reason "consumption" or "phthisis." It stands usually in direct relation to the stage and chronicity. This affects all the organs except the liver, which may undergo a fatty change, and possibly the bones. The fatty and muscular tissues are most affected. Loss of weight, the most prominent and in a few cases the only symptom, may occur so gradually that it escapes attention for some time, or it may be very rapid in the early as well as in the later stages, but those with slowly advancing disease may lose little or no weight. Loss of weight is in proportion to the duration of the disease, and young patients lose more rapidly than older. The usual weight of patients with pulmonary tuberculosis is about 10 pounds less on an average than what they should weigh. Loss of weight is due to the effect upon cell nutrition in general of the poison absorbed from the pulmonary lesion. This, affecting simultaneously all the systems, causes directly a deficiency in the digestive ferments (Hays) and a loss of appetite and so prevents repair of the waste of the body. This favors extension of the disease, increased poisoning, and in time the cellular protoplasm gradually loses its power of regeneration, which late in the disease is accentuated by vomiting and diarrhœa. The fever causes increased metabolism and hastens loss of weight, but this may occur in the absence of fever. The loss of weight from nervous excitement and exercise can be explained by the increased absorption of poison.

Loss of weight in chronic disease may amount to one-third to two-fifths of the previous weight. If a patient lose one-fourth of his normal theoretical weight his nutrition is apt to be considerably disturbed and a loss of one-third is a grave omen. A larger percentage can be lost by fat individuals. Great emaciation is rarely present in acute disease. The greatest loss recorded is 130 pounds in a man weighing 271 pounds in health. A loss of 5 or 6 pounds a week is not unusual for a short time.

Gain in Weight.—This depends not upon ingestion, but upon assimilation. Patients who are so fond of meat that little else is eaten are less likely to gain than good general eaters. Many patients who have had high fever gain in weight when the fever decreases, although a continuously elevated temperature may still be present. Gain in weight, if much loss has occurred, is practically a necessity for improvement. Many patients in advanced stages gain in weight for three or four months after a change of regime or of climate, but then gradually lose.

Cold seems to have a marked influence upon weight-gaining in the healthy as well as in the tuberculous. The weight curve in pulmonary tuberculosis, if not influenced by change of climate or other factors, rises from August to Christmas (sometimes to November), remains more or less stationary with minor fluctuations from Christmas to Easter (March), and sinks gradually from Easter to August. This corresponds closely with the normal weight curve and is based upon a study of the weight charts of 1200 patients at the Trudeau Sanatorium. Some patients at rest gain little, but with carefully regulated exercise begin to gain at once.

The average gain of weight under treatment depends upon whether or not forced feeding is employed, the activity of the symptoms, and the amount of weight that has been lost. Patients with far-advanced disease and considerable loss of weight usually gain more when the disease becomes quiescent than those with advanced but less than those with minimal disease. The largest gain in weight known to the writer occurred in a man with a cavity and extensive disease on one side, and a slight affection of the opposite apex. Returning to his work against advice, his weight fell from 145 to 115, and his lung condition became worse. During a second sojourn of two years his weight increased to 230 pounds. In 2 patients, in early stages, without much loss of weight, gains occurred of 15 pounds in fifteen days and 27 pounds in twenty-eight days. A gain of 2 pounds a week is satisfactory. Weight may be gained irregularly, *i. e.*, a gain may occur on the first and third days and a loss on the second. The mental condition directly affects the weight. The gain in weight in many cases occurs first on the chest and face, but is most marked on the hips in women and abdomen in men. Men, as a rule, lose more and gain less than women.

The *persistence of the gain in weight* is often remarkable. In some cases (about one-third, Berger) the gain is continued when the patient returns to his home and lives properly. Weight gained during exercise is more permanent than weight gained at rest. Weight acquired through a liberal use of milk and eggs, especially if without exercise, is often quickly lost.

Metabolism.—The basal metabolism is usually normal but may increase 30 per cent. with a temperature of 104° F. The tendency to increase may be offset by the reduction due to decrease of weight. McCann concludes that forced feeding, especially of proteins, is unnecessary and probably harmful in active tuberculosis. From studies in the Alps it was found that heat production was increased 40 to 50 per cent. in clothed adults out of doors, 60 to 90 per cent. in partially nude children, and 200 per cent.

Heart-beat (Christiania) May 1928,

in clothed children on a windy, cloudy day. As the disease advances there is a decrease in the alkali reserve but at no time does a marked "acidosis" occur. There is no evidence of any demineralization. The calcium and silica metabolism is not altered except in connection with the loss of weight. There may be a slightly increased loss of phosphorus. Toxogenic destruction of protein takes place independent of secondary infections. The purin bases and creatinin excretion are increased.[1] Some hold that a pluriglandular insufficiency occurs in advanced cases.

Respiratory Exchange.—The gaseous exchange in the lungs, in spite of marked destructive processes, undergoes practically no alteration.

Loss of Strength.—This often occurs as the primary manifestation, but is rarely recognized as such at the time. Many patients begin early to tire easily, and work begins to drag. This debility may be present to a very marked degree and out of all proportion to the extent of the discoverable lesion. A point often mentioned by the patient is that while he seems to have as much muscular power as ever for a single act, he is incapable of sustaining for any length of time muscular or, in some cases, mental work. The general muscular tonicity has been found greatly diminished in the incipient stage, even when the muscular power and nutrition are good. The loss of strength is most probably due to the effect of the disease upon the nervous system.

As the disease progresses and, in fact, often within a few weeks after the patient has "given in," he feels much better. Loss of strength is of course directly proportional to the general condition. Nothing is more deceptive than the robust appearance of many patients undergoing the modern treatment when compared with the lack of strength. The slow return of strength is a most striking feature in many cases and of considerable importance in treatment. In far-advanced cases the debility may be extreme, and yet, it is remarkable what many patients, seemingly on the brink of the grave, can accomplish.

Night-sweats.—These, while rare in the early stages, occur more frequently in pulmonary tuberculosis than in any other disease but are less common than formerly. In a few cases they precede all other symptoms and even physical signs. This, however, is rare, as they are usually associated with fever and a subnormal morning temperature. As the disease progresses, or during acute attacks, the night-sweats become more frequent, and in the later stages drenching sweats may occur not only at night, but whenever the patient falls asleep (sleep-sweats). The sweating, so exhausting and so depressing that the patient dreads going to sleep, usually occurs early in the morning and possibly not until during a nap following the morning cough.

The sweats vary much in severity. At times so slight as to be scarcely perceptible, they may be so profuse that the night robes have to be changed several times a night and possibly some of the bedding as well. Sweats were absent in 10 per cent. of Louis' cases and in 41 per cent. of 2344 cases at the Phipps Institute, Philadelphia. Sudamina, more frequent in acute, rarely occur in chronic cases following sweats. Acute

[1] See Chemistry of Tuberculosis by Wells, DeWitt and Long, 1923.

inflammatory processes and diarrhœa may lessen the sweats for a time. They are less frequent in children and in patients with diabetes mellitus. Hemidrosis may occur, but is accidental. The night-sweats are general when severe, but the slighter forms are often localized, most frequently about the head and neck or chest. The sweat has been found in some cases to give a tuberculin reaction on injection, but never contains tubercle bacilli. The amount of sweat may exceed 20 ounces.

Cause.—The sweat glands are under the control of centres which can stimulate or inhibit the secretion. Increased blood supply to the skin increases secretion of sweat, and these glands are closely connected with the vasomotor centre. Early in pulmonary tuberculosis, sweating is usually the result of poisoning of the sweat, vasomotor, and heat centres; in the more advanced stage the sweat may be the result of fever, which stimulates the sweat centres, the vasomotor centres (causing dilatation), and the glands; and late in the disease the sweat centres or glands may be stimulated independently of the heat and vasomotor centres by the poisons.

The increased frequency of sweating in acute processes is due probably to the more rapid absorption of poisons. Some hold that overstimulation of the vasomotor (constrictor) centre finally gives way during sleep to a greater relaxation than normal. The increased blood supply then causes the sweat. The presence of the poison, however, is not always sufficient to cause sweating, and some pathological changes in the circulation and nutrition are generally necessary. The absorption of necrotic matter or of pus is, according to some, the chief cause. In most cases the sweat glands respond to slighter stimuli than normally.

Chills.—These may occur early in the disease, and when present daily often give rise to a diagnosis of malaria. They occur usually before and during, seldom after, the rise of temperature. Following a sweat, chills are not infrequent.

Blood.—The blood picture varies with the stage, the acuteness, and the complications. In patients with minimal disease it is often normal, and during treatment the erythrocytes and hemoglobin and possibly the amount of blood are frequently above normal. Other patients are anemic from the outset. The earliest and most constant change is the reduction of the color index, and anemia in many instances is masked tuberculosis. A slight diminution of the red cells is frequent in this group, while the leukocytes may be slightly increased, decreased, or, as is more usual, normal. When the disease reaches the advanced stage, the pallor of the face, which may be present earlier, becomes often very marked, and is at times in strong contrast with the red color of the lips and mucous membranes. The blood here is often normal and the red cell count and hemoglobin may be above normal. The leukocytes are usually very slightly if at all increased. The explanation lies in the concentration of the blood and a real leukopenia. The large amount of fluid lost by the increased salivary and bronchial secretions, the night-sweats, and diarrhœa if present, and probably also the action of the tuberculous poison producing an increased flow of lymph to the tissues, are all factors.

Nuclear
Salivas.

Health (JAMA 142, 5, 8 3/01 adult) Subnormal values of bl. sugar in majority of adm. V. s.

Leukocytes.—In acute miliary tuberculosis of the lungs, leukopenia is more often present than leukocytosis. The latter is at times present in caseous pneumonia. In chronic fibroid conditions leukocytosis is usually absent unless a cavity is present. Tuberculous complications, unless accompanied by secondary infection, rarely produce much increase in the leukocytes. During softening a leukocytosis is usually present and it may occur with tuberculous hyperplasia of the glands with slight destructive pulmonary changes. Leukocytosis is said to be a constant accompaniment of cavity formation, and a prolonged absence of leukocytosis is held to exclude this condition. Such however, is not always the case, especially in chronic cavities (Ewing). Acute tuberculosis supervening upon a leukemia may reduce markedly the number of leukocytes, but chronic pulmonary tuberculosis and leukemia may coëxist without reduction in the number of leukocytes. Intestinal tuberculosis is often accompanied by leukocytosis.

The differential count shows considerable variation. The polymorphonuclear cells vary between 60 and 95 per cent., but are usually about 80 to 84 per cent. Leukocytosis in pulmonary tuberculosis is almost always due to increase of these cells. Some have tried to show a prognostic value for this type of leukocytosis, believing a low mononuclear count decidedly less favorable than a higher one. In low counts the large and small lymphocytes are usually relatively and possibly absolutely increased. Myelocytes may be present, but mastzellen rarely occur. The blood platelets are normal, decreased, or increased. Even in the most advanced stages their number may not be reduced.

Arneth, from a study of the polymorphonuclear leukocytes, found that in health 5 per cent. contained a single nucleus, 35 per cent. two nuclei, 42 per cent. three, 17 per cent. four, and 2 per cent. five nuclei. Other observers have found in health a considerably larger percentage of cells with one nucleus, and more cells with two nuclei. In pulmonary tuberculosis the number of cells with fewer nuclei was much increased. Iodophilia is of little value in pulmonary tuberculosis. The alkali reserve is decreased usually in far advanced cases.

The *bacteriology of the blood* has been frequently investigated with very contradictory results. That tubercle bacilli occur in the blood cannot be questioned and some work suggests that more exact methods will yield more positive results. A tuberculous septicemia, with little or no localization of tuberculosis, has been described (Landouzy). The positive results for other organisms are more numerous, but many have been questioned. Faulty technique would account for some, but there remain a number of cases in which other organisms have been recovered.

Circulation.—The Pulse.—The frequency and tension are early and often permanently changed. The size of the pulse, its fulness and regularity, bear less definite relation to the pulmonary disease than the frequency and tension, and often until the late stages are only slightly, if at all, abnormal. The radial pulse is said to be influenced by the position of the arm on the affected side when contraction of the apex has occurred.

Frequency.—The pulmonary patient borders constantly upon the verge of excitement, and the visit of the physician or a call at his office will often increase the pulse twenty beats a minute. The best record is that taken at the patient's home by a nurse to whom he is accustomed. Altitude increases the pulse-rate somewhat, which may decrease in a short time or persist.

The majority of patients have at first a slightly increased rate (90 to 100), even when apyretic, and frequently when at rest in bed. The pulse-rate and temperature may be independent, but more usually there is a rather close connection between the two, which some express by allowing ten beats for each degree of fever. An increase above this rate, they think, is due to cardiac weakness. Forced feeding may produce slight acceleration of the pulse for a time. In some cases the pulse shows increased rapidity for short periods, but this is unusual, as when it once becomes rapid it usually remains so for some time. Mental excitement, slight exercise, coughing, and a full meal have a strong tendency to increase the rate in early and advanced cases. In the latter the pulse tends to be constantly rapid, and, varying somewhat with the temperature, increases slightly every afternoon. The range is usually between 88 and 120. This tachycardia is seldom noticed by the patient. Often as he improves and after the temperature is normal the rate gradually decreases, but it may quickly fall to normal and remain so. Slight tachycardia may persist in healed pulmonary tuberculosis.

The *cause* of the increased rate is unsettled. It has been attributed to pressure upon the vagus by enlarged tracheo-bronchial lymph nodes, an explanation which does not suffice in many cases. Brehmer thought the underdevelopment of the heart and the overdevelopment of the lungs were important factors. Another view is that it is due to the increased work thrown upon the heart by a narrowing of the lumen of the pulmonary vessels, or to a narrowing of the air passages, which Marié found diminished the number of respirations and accelerated the heart. A neuritis of the vagus, the fall in blood-pressure, irritation of the sympathetic, increased irritability of the cardiac ganglia or muscle fibers, myocarditis, anemia, and dyspepsia have all been suggested as factors, the most probable cause, expecially in minimal stages, is a weakening of the cardiac muscle and its nervous control due to the poison. Valvular disease of the heart in pulmonary tuberculosis exerts little influence upon the pulse-rate.

Blood-pressure.—In some cases this is lowered from the very outset, and some have held that hypotension is present in the predisposed. It is held by many to be due to tuberculous poison such as tuberculin, which undoubtedly lowers tension (Teissier). As the disease advances and pronounced constitutional symptoms occur, the blood-pressure becomes less and 100 systolic is not uncommon, but many early and moderately advanced cases have a normal pressure. A much greater variation exists between the blood-pressure in a reclining and in an upright position than in health.

Heart.—The heart may show little change throughout the entire course. It has long been held that it is reduced in size, and upon this Brehmer

Arterial tension and thec. C. Glasgow: Pr Med 1928, Dec 29, 1579
Good review. Q.D. norm. in appetites & good gen'l cond, ban & early
lowering connects w fever, fatigue, cachexia, or poor gen'l cond.
Also in serious acute attacks. Arb. Pneumo affec. no effect

founded one part of his treatment, graded walks. More recent observations have shown that hypertrophy is only a little less frequent than atrophy, which usually occurs only in cachectic patients. Many complications produce an hypertrophy, so that it is difficult to draw any conclusions at autopsy in regard to the heart early in the disease. The orthodiagraph has, it seems, shown a slight atrophy in minimal and hypertrophy or dilatation in far-advanced stages.

Displacement of the heart usually occurs gradually, but in some patients transposition to the right side seems to take place within a few days. The shrinking of the right lung frequently increases the area of pulsation and may so displace the heart that the pulsation is limited entirely to the right side, extending in some cases beyond the mid-clavicular line. Retraction of the left lung may cause cardiac symptoms varying from slight discomfort to pseudo-anginal attacks.

Murmurs are not uncommon at the apex or base, but in the writer's experience are more frequent at the apex and usually systolic. Some occur in patients without anemia, where the displacement of the heart, if any, is slight, and where we explain the murmur as due to pressure upon the great vessels. These patients show no cardiac hypertrophy. In a few patients murmurs occur in the interscapular region. Consolidation may transmit the murmurs widely. A cavity near the heart may alter the sounds, and murmurs synchronous with the systole are not infrequent in these cases. Murmurs may be produced in cavities by the systolic distention of a large vessel or of an aneurism.

Acute dilatation of the right ventricle occurs far less frequently in tuberculosis than in other pulmonary diseases. Dilatation of the right side of the heart in advanced stages is, however, more frequent than many observers have held. In many chronic cases, with the intrapulmonary vessels obliterated or reduced in size, accentuation of the second pulmonic sound occurs and the shock may be palpable. The pulmonic second sound is at times reduplicated (best heard when the patient reclines). A weakened first sound is rather frequent in advanced stages, and often more pronounced during acute attacks.

Palpitation in neurotic subjects is usually associated with hypotension. The slighter forms are frequent and few patients entirely escape them. The severe forms occur occasionally after too vigorous exercise, and are most common in advanced stages. They are more frequent at puberty and at the menopause, sometimes precede hemoptysis and accompany dyspepsia. Some have noted pain in the neck along the vagus. Cardiac distress, due at times to dislocation of the heart, may be found in a few patients not suffering from palpitation. Paroxysmal tachycardia is rare.

Vessels.—Temporary dilatation of the subclavian artery was described by West, who thinks it not rare. Dilatation of the venules, possibly due to pleuritic adhesions, upon the upper thorax and about and above the costal margin is quite common. A murmur over the subclavian artery, first described by Stokes, is not unusual under the outer third of the clavicle, and has been held to be of diagnostic importance. It is more common on the left side and is rare in women. It may appear or increase during inspiration or expiration, and is due to anemia or to compression

of the vessel by a thickening of the pleura or by a muscle. The murmur is not constant, is usually soft and blowing, and the position of the arm or pressure by the stethoscope may alter it. Œdema of the lower extremities is rare except in the very late stages, when it almost invariably indicates great cardiac weakness.

Cyanosis.—This may persist for years while the patient enjoys comparative health. In many it is more pronounced in the morning. In the late stages the lips and nails become blue and the face and extremities are often cyanotic. In early stages it seldom occurs except as the result of severe pleurisy or cardiac complications.

Skin.—The skin undergoes changes due to malnutrition. In many patients in early stages, especially under treatment, the skin is clear, ruddy, and normal. The chilliness and undue sensitiveness to cold are less frequent than formerly. In the majority some pallor of the skin is present and often the vessels are well seen through the "skim-milk" complexion (tuberculous diathesis). In some the skin is dull and opaque and the complexion muddy (scrofulous diathesis). In late stages the skin is often dry and harsh, and even furfuraceous (pityriasis tabescentium). The sebaceous and sweat glands may be stimulated and the skin become oily. A pungent odor from the sweat is often noticed.

Pigmentation occurs rather infrequently and may consist in a general bronzing of the skin, less marked than in Addison's disease, or in a patchy, light yellow to pale brown, often shiny pigmentation, which may occur on the face or trunk, the so-called chloasma phthisicorum. A connection between intestinal disorders or change in the spleen and lymph glands has been suggested as the cause of this, which is said to be more common when the peritoneum is involved. Icterus is rare. An erythema is occasionally present, and, while usually accidental, may at times be due to a tuberculous poison. It occurs with acute conditions and adenitis, and in some appears only when the fever is at a maximum. It may closely resemble the rash of scarlet fever, but usually spares the mucous membranes. Petechiæ rarely occur. Purpura may occur and some think it is occasionally due to the tuberculous poisons. Œdema of the skin rarely occurs except in complications or late in the disease. The hectic flush in late stages or a reddening of one cheek and ear in moderately advanced patients is common. Subcutaneous emphysema, with crackling on palpation, due to a rupture of the lung, is rare, except after collapse therapy. Local tubercle may develop on the hand. Herpes labialis occurs periodically with slight gastric disturbances in some patients, and is not uncommon after a tuberculin reaction.

Hyperesthesia of the skin is common and is often elicited on percussion. It is said to spread or contract with the advancement or retrogression of the disease, and to be more acute when there is fever. In lesions of the upper lobe it is most frequent in the supraspinous fossa.

Hair.—The nutrition of the hair suffers especially during fever. It often becomes dry and lanky, and may split. The hair may come out in considerable quantities, but the alopecia is seldom patchy, partial, or complete. In children and young persons the body is sometimes covered with a growth of fine, downy hair (Kidd).

Nails.—The down-curving of the nails may occur without, although often with, clubbing of the fingers (Hippocratic digits), and is thought to be due to the loss of fat on the palmar surface and malnutrition of the matrix, as well as circulatory disturbances. The ridges, furrows and pits which occasionally occur are due also to poor nutrition. Watch-glass nails, down-curving equally in all diameters, suggest amyloid disease (Holmgren).

Alimentary System.—Symptoms referable to this system occur sooner or later in nearly every patient, and while not as frequent as symptoms referable to the respiratory system, rank second.

Gums.—The gums in advanced cases, owing to the poor nutrition, are often spongy and soft, and pyorrhœa is not infrequent. A red line on the gums is not peculiar to pulmonary tuberculosis. Its cause is undoubtedly a mild gingivitis. Bleeding of the gums is very common and caries of the teeth frequent, due possibly to the gingivitis.

Tonsils.—The tonsils may be hypertrophied, but adenoid tissue is rarely present. Chronic granular pharyngitis is common. Stomatitis is infrequent in early cases, but aphthous ulcers occur at all stages. Thrush may occur on the soft and hard palate, tonsils, tongue and mucous membranes of the cheeks. Usually of slight importance, it may penetrate into the deeper vessels, cause thrombosis, and even produce cerebral metastasis. It usually occurs late and is of evil omen.

Digestion.—The digestion may be good to the end and many patients recover without the slightest disturbance. A majority (70 to 90 per cent.), suffer at some time from digestive disorders, and women more than men. The type of the disease seems to exert less influence than its acuteness. Patients who escape have usually been good eaters, and the appetite is the best guide to the digestion. Alcoholics and those who have abused their digestion usually pay heavy penalties. Distress or anorexia may occur while apparently all the gastric functions are normal, but on the whole the gastric tolerance is remarkable. In many patients with gastric disturbance no pathological changes in the stomach, except possible slight hyperemia, have been found. In many instances the gastric disturbances are reflex phenomena of intestinal tuberculosis.

The gastric juice is normal in many early cases (50 per cent., Brieger), but as the disease advances it is frequently abnormal, and in severe cases over 80 per cent. show some change. Hyperacidity may be present in early stages, while later subacidity is more common. The secretion of HCl is independent of the fever, but with other constituents of the gastric juice seems to be reduced in far-advanced stages.

The motor functions of the stomach usually run parallel with the condition of the muscles in general, and accordingly the motility may be deficient in advanced but also in some early cases. The rapidity of absorption is little changed at first but with dilatation and loss of motility is much diminished. Gastroptosis is occasionally present.

The appetite usually fails and after meals some distress is noticed, varying from slight distention to actual pain or cramps. Eructations are not uncommon but pyrosis is infrequent. In some cases eating is followed by cough and cough by vomiting without nausea. This occurs more

frequently after the evening meal, as the morning cough has in most cases completely cleared the air passages. The vomitus in these cases usually consists of undigested food. A peculiarity of this vomiting is that the patient is often able and willing to eat again at once. This vomiting is due to the increased abdominal pressure during (a fit of) coughing and possibly to lessened tone of the musculature at the cardiac orifice. The cough is caused by rapid absorption of the fluid and increased secretion in the lungs.

Anorexia.—When tissue hunger is greatest, wrote Dettweiler, the appetite is often least. Anorexia is rarely complete in the earlier stages unless profound constitutional symptoms are present. Many patients complain of no appetite, but eat, and eat well, and these are less liable to digestive disturbances. Again, many patients are hungry until they see the food or until a few mouthfuls are taken, then appetite may be replaced by nausea. The appetite is frequently capricious, good for one meal and lacking for several, or good one day and lacking for several, but on the whole it diminishes as the disease progresses. The tastes may undergo striking changes, and food once relished becomes repugnant and strange articles of diet are craved. An antipathy to fats exists in some patients. Desire for food is at times closely connected with fever, and at noon or evening, whenever the maximum occurs, the appetite is poor or lacking. This is not always the case, as many patients with high fever eat well.

Pain.—Slight gastralgia is frequent in early as well as in late stages. In others the pain occurs regularly immediately after eating or later, and is rarely the only symptom present. Distention is a frequent cause. Pain in the epigastrium, immediately after eating, may occur when the stomach is normal and ulceration is present in the colon.

Nausea.—This is common at all stages and may occur for some time before the physical signs are sufficiently pronounced for diagnosis. In the terminal stages it is often present and accompanied by vomiting. Many times it occurs only in the morning, and may prove most stubborn. Again, it comes on when after a few mouthfuls the appetite vanishes and the patient tries to force down a little more food. It often occurs without vomiting and may cause much distress.

Vomiting.—This may occur with or without nausea. Without nausea it is usually due to violent paroxysms of cough and is more frequent in basal lesions or when a change of posture is made, generally on arising. One patient with a large cavity in the upper lobe vomited every morning and never expectorated at any time. Vomiting after nausea or other gastric symptoms is less frequent, but far from uncommon, especially in the later stages. In the first case the patient is often able to eat again at once; in the second the thought of food is repugnant. Other causes are nervousness, pressure upon the vagus by bronchial glands, hyperesthesia of the posterior pharyngeal wall (sputum furnishing the necessary irritation), and nasopharyngeal catarrh. Vomiting may precede all other symptoms and persist after the disease is arrested.

Intestinal.—Constipation is frequent, and is no doubt in part due to the milk diet, in part to lessened peristalsis, caused possibly by the weakened musculature. Whatever the cause, it is most troublesome

and needs careful attention. It may be present until death, notwithstanding severe intestinal ulceration.

Diarrhœa.—This may occur for months before a diagnosis is made. The swallowed sputum can set up an enteritis, which is more marked by its chronicity than by the frequency or profuseness of the stools. This form is more frequent in women, but may be caused by sputum swallowed during sleep. The tuberculous poisons may cause diarrhœa by irritation of the sympathetic system and increased peristalsis, by catarrhal enteritis, or by superficial erosions. It is usually due to *intestinal* tuberculosis when large amounts of nitrogen may be lost in the feces. Fat diarrhœa may occur in intestinal amyloidosis and when the mesenteric glands are involved.

Many tuberculous patients have diarrhœa from apparently trifling causes. In some, milk or raw eggs produce a pronounced griping and diarrhœa. Chilling of the abdomen and slight indiscretion in diet are sufficient in others. The cough and expectoration may diminish when the diarrhœa increases.

The liver and spleen are seldom affected.

Genito-urinary System.—In pulmonary tuberculosis, when unaccompanied by clinical evidence of renal disease, tests for renal function show a normal or only slightly lowered function in all stages of the disease (Mills and Henderson).

Urine.[1]—The liberal milk diet often accounts for the increased amount, but a true polyuria can occur. Some oliguria may be present in far-advanced cases. A decrease in the solid residue occurs in advanced stages and may fall below 30 gm. when cachexia sets in. The urinary salts vary with the temperature and the stage of the disease. The chlorides may decrease in exacerbations or when profuse expectoration occurs, but are usually normal.

Phosphaturia is held by some to be an early indication of pulmonary tuberculosis. Calcium phosphate predominates and increases as the emaciation progresses. Both calcium and magnesium increase at first and later decrease. Phenol has been found in the urine, especially just before death. Indican occurs more frequently, especially in children, than in health. Acetone, sugar (without diabetes), peptone, and albumose have been found. Albuminuria, rare in early, and hyaline or granular casts are usually found only in advanced stages. Teissier described an intermittent form in young individuals with a family history of pulmonary tuberculosis. An orthostatic form has been described.

In a study of the urine in 449 patients with pulmonary tuberculosis, Shapira and his associates found it normal in 220. Albumin and casts were present in 229 and 151 had some other trouble than simple, chronic nephritis. Of 91 cases with acid-fast bacilli only 23 produced tuberculosis in guinea-pigs, while of 60 without acid-fact bacilli 2 were positive. Tubercle bacilli can occur without symptoms, and tuberculous vesical lesions without tubercle bacilli. It is no proof that because injection of urine or its residue causes a "reaction" similar to that produced by

[1] See Wells, DeWitt and Long, Chemistry of Tuberculosis.

tuberculin, that tuberculin is in the urine, for other substances may cause this reaction, more recently described as the auto-urine test (Wildbolz).

Inflammation and displacement of the uterus are caused by an aggravation of preëxisting trouble, and in some cases by cough.

Menstruation.—This may be scanty or cease early in the disease, especially when the patient is anemic. Change of residence affects some patients. An onset at the time of puberty may delay menstruation for years. As the disease advances the menses usually, if not previously disturbed, become irregular and finally cease. With improvement menstruation begins again. In a few the menstrual function continues to the end. In some cases the symptoms and physical signs are undoubtedly more pronounced at this time. The premenstrual fever for about one week before menstruation is well recognized, while many hemoptyses occur and recur or the expectoration may be increased or present only during this period. Dyspnœa, night-sweats, an increase of basal metabolism and raised blood-pressure may also occur.

Pregnancy.—This can occur in very advanced stages. During it the disease is often in abeyance, to proceed more rapidly after parturition.

Nervous System.—The nervous system is often early affected, and few patients entirely escape some nervous disturbance. This would be expected in neurotic individuals, but while usually more pronounced it is by no means confined to them.

Psychical Changes.—An alteration in the disposition is not infrequent, but is in many cases only "apparent," as in a large number the real character is laid bare. By many all pretension is thrown aside and selfish traits, fostered by foolish parents, may become so pronounced that the patients try to exert despotic sway over their associates and attendants. Fortunately, these examples are rather rare. Some dispositions, naturally quiet and refined, seem as the disease advances to become so unselfish, so ethereal that they suggest another sphere in more ways than one. Chronic invalidism rarely leaves the character unchanged and treatment which constantly enforces self-consideration is not conducive to unselfishness. And yet years of institutional life and the constant solicitude of the family and friends affect singularly little the character of many chronic tuberculous patients.

Indecision, vacillation, and changeableness are frequent characteristics in some patients. Their judgment of men and affairs, their plans and outlooks, often change from day to day, or may be entirely reversed. Forced inactivity produces lack of concentration in some. The mental faculties are generally well preserved to the end and may become more acute and out of all proportion to the bodily strength. The patient may plan and attempt to put into execution at once many schemes consigned to failure at the outset. In a few, ideas of self-importance and of grandeur, great nervous irritability, suspicion and susceptibility to suggestion, are marked.

This, however, is not a true picture of the ordinary tuberculous patient. The vast majority, though depressed at first, soon rebound and improve or fail, they remain the same men and women they were before they

became sick. They quickly recognize the serious illness of a fellow patient and it seems impossible that they should not realize the gravity of their own condition but the *spes phthisica* is common and may be pronounced to the end. The vulgar opinion has been until recently so pessimistic that it is impossible for patients to escape its influence entirely, and many arguments are necessary to convince them of the possibility of a "cure."

Neuroses. Neurasthenia is more common in pulmonary tuberculosis than in any other disease and few escape it. No doubt it has a basis in the poisoning of the higher centres. At first it may be so pronounced that it masks the tuberculosis, which may be overlooked for some time, or it develops when the patient is well on the road to recovery and forms a serious complication. Physicians and nurses are peculiarly prone to this neurasthenia. Pressure in the head, giddiness, fear, anxiety, vasomotor disturbances, and especially sleeplessness are common. When pulmonary tuberculosis occurs in neurasthenia or hysteria the nervous symptoms are usually increased. Hysteria occurs much less frequently and most often just before or during the menstrual period. It tends to disappear with the progress of the pulmonary disease, and is rare in men. Aphonia is not uncommon, but convulsions or spasms are rare

Psychoses.—Psychoses are very much rarer in pulmonary tuberculosis than pulmonary tuberculosis in psychoses. Two classes may be recognized: "First, a group peculiar to the disease itself; second, a group including the usual types of insanity determined by a lowering of nutrition" (McCarthy). In the first class are patients with no hope of recovery, but happy and contented and often with a decided grade of unreason. They closely simulate paresis. This type differs from the form described by Clouston, in which depression advances to melancholia, and morbid suspicion, marked loss of memory, a desire to be alone, irritability, and delusions of persecution occur.

The second group includes melancholia, mania, dementia præcox, hysterical insanity, and delusional insanity. Melancholia develops early, rarely late in the disease, but mania is rare. Suicidal tendencies are not uncommon in these. The age incidence of pulmonary tuberculosis is the same as that of dementia præcox, and the association of the two diseases may be thus explained.

Tremors are common and usually occur on voluntary effort. The reflexes are often exaggerated, but may be decreased or absent, especially in marked asthenia. The knee-jerk is increased in one-half of the early cases. The ulnar reflex is held by McCarthy to be very suggestive of pulmonary tuberculosis, and may occur only on the affected side. This author found Chvostek's phenomenon present in 16 out of 287 cases of pulmonary tuberculosis.

Neuritis.—The peripheral nerves are seldom affected, and sensory are much more frequent than motor disturbances. The lesion can be limited to a single nerve, a plexus, or involve all the peripheral nerves. The leg is usually more affected than the arm, and the external perineal nerve may be the first affected. Atrophy of the affected muscles occurs, but usually a few are spared in an extremity, and so some motion is preserved. Paresthesia often precedes this type. Sensory neuritis may

affect the skin, muscles, periosteum, and joints, or an entire extremity (acro-paresthesia). Neuralgia of the intercostal nerves, the trigeminus, of the sciatic, and other nerves is common. Arthralgia, meralgia, myalgia, and dermalgia all occur.

Pressure neuritis may occur in the vagus, due to enlarged bronchial glands, and is manifested by rapid pulse, cough, dyspnœa, hoarseness, and laryngeal spasm or paralysis. Pressure on the sympathetic by retraction or thickening of the pleura may, by its cervical and brachial connections, cause a dilatation or contraction of the pupil or neuralgia in the arm. Dilatation of the pupil may occur before the pulmonary symptoms are manifested. Pressure of glands upon the recurrent laryngeal nerve may cause hoarseness.

Pulmonary disease can cause, as Head has shown, *referred pains*, irritative phenomena, hyperalgesia and neuralgia, in the skin of the neck and thorax by the connections of the sympathetic and vagus. Some have tried to connect the hyperalgesia with the location of disease and others have proved that muscle spasm first and then atrophy occur in the muscles of the thorax (Pottenger). Connection with the trigeminal nerve may cause pain in the forehead, eyes, and head. The neuralgic pain may occur suddenly, dart from front to back, is little affected by ordinary breathing, but may be by deep respiration. Pressure lessens the pain, which is most frequent in the initial stages.

The *vasomotor* nerve supply is very unstable, and limited redness of the skin, especially of one cheek on the affected side or of both cheeks, elevated temperature in limited areas, localized asphyxia, sweating and ecchymosis, and a syndrome simulating hyperthyroidism, are all probably the result. Myoidema is probably a functional nervous derangement of the muscles. Hoarseness, depending upon a weakness of the adductors, is due to the same cause.

Sexual desire is held by many to be increased, but this is in all probability due rather to the fact that pulmonary tuberculosis usually attacks young adults in the prime of life, and that the treatment consists of abundant feeding, enforced rest, and lack of occupation.

Herpes zoster, due to changes in the posterior root ganglion, is not rare. It is most frequent in the ninth to the twelfth dorsal segments, but occurs on the face, and in one patient extended over the right leg as low as the knee. There seems to be no connection between the pulmonary lesion and the side affected. In some cases the hemorrhagic variety occurs.

Headache is frequent, often stubborn, hard to control, and bears no relation to the extent or stage of the tuberculosis. It is rarely so severe that sleep is lost. It is frequently due to overuse of the eyes with poor muscle balance or weakened musculature, but may occur from functional disturbances as well as from organic lesions.

Sleep.—Insomnia is not infrequent. Change from an active to a quiet life, indigestion, cough, fever, sweats, and more rarely pleurisy may all contribute; but neurasthenia and nervousness are frequent causes. It often occurs periodically, and high altitudes may increase it.

Cough.—Frequency.—Cough is the most frequent and, as a rule, the most constant of all symptoms in pulmonary tuberculosis. It usually

first draws attention to the lungs, but a slight cough may exist for months and attract little notice. In rare cases cough is absent throughout, and not very infrequently a patient is seen with a well-marked cavity whose cough has passed entirely unnoticed.

Other things being equal, the cough varies in frequency with the amount and character of the expectoration, but no direct relation exists between the gravity of the disease and the severity of the cough. It depends to a considerable extent upon the nervous excitability of the patient and the part affected. The mucosa of the respiratory tract, while not equally sensitive throughout, appears less irritable from a point 1 cm. below the larynx to another 1 cm. above the bifurcation. (C. Jackson). Irritation once begun may rapidly increase and spread to parts showing previously slight susceptibility, but tolerance is often quickly acquired. The pulmonary tissue has little or no sensitiveness. It is probable that when the primary focus is near one of the main bronchi which becomes involved early the cough is more severe. In some instances the patient can select a definite point as the origin of irritation causing cough. Cough and expectoration may increase during the menstrual period, and youth as well as fever seem to increase the cough. An acute pleurisy rarely causes and frequently checks cough, but a chronic pleuritic irritation may produce a dry, hacking cough.

Varieties and Cause.—Cough in the majority of cases is at first short, dry, hacking, not hard, and rather frequent. It may occur throughout the day or more frequently be limited to the early morning hours or night. As the disease progresses the cough becomes looser, productive, and in many cases more frequent, especially when softening is taking place. In patients with a catarrhal onset the cough is frequently loose from the onset. The character varies with the amount of secretion and the part of the respiratory tract affected. Before the bronchi are affected the cough is usually dry, short, and hacking; after they are affected the cough is similar to that in simple bronchitis. Cough may be divided into dry and productive. A dry cough may be due to irritation of the respiratory tract or to a reflex. The occurrence of ganglionic cells communicating with branches of the vagus, and sending a nerve supply to the bronchial mucous membrane and its glands, suggests that involvement of these cells may explain in part the excessive cough present at times.

The *productive cough* is caused by the irritation of the mucosa, usually by the slowly or rapidly collecting secretions. The morning cough is usually the result of the irritation of the sputum slowly gathered during the night. Change of position and sudden contact of the secretions with other parts of the mucosa no doubt play some part. This is true in many cases with cavity, where either a change in position or an overflowing of the cavity causes continuous cough until the vomica is emptied.

The explanation of the cough frequent with many patients *on retiring* is more difficult. Sudden contact of the secretions with parts of the respiratory mucosa hitherto for a time free, impact of air on parts of the larynx previously protected, congestion of the larynx due to the position of the head, hyperemia of the internal organs due to contraction of the

peripheral vessels from the contact of the skin with the cold sheets or cold air, increased difficulty of expectoration, hyperemia, and consequent increased irritability of the respiratory centre (which is lessened during sleep) have all been offered as explanations.

In a few patients cough continues to be noticed *after meals*, especially after breakfast, when it has ceased at all other times. This is due chiefly to the hot fluids taken with the meal, but increased cough may occur from food by irritation of the upper respiratory tract, rendered more sensitive from inflammation or ulceration, either by direct contact with the food or by the movements of the œsophagus or pharynx, by direct pressure upon the trachea or bronchi by enlarged glands as masses of food pass by them, by the temperature of the food, by the pressure of the distended stomach upon the diaphragm, or by the inhalation of steam from warm drinks. Increased frequency or depth of respiration as in laughing, rapid talking, and fast walking may cause cough.

Paroxysmal cough may be due to the emptying of large cavities, to ulceration at the tracheal bifurcation, or to irritation by enlarged bronchial or mediastinal glands. The respiratory efforts are not so close together, but fully as prolonged and exhausting as in whooping cough.

The *emetic cough* is common in advanced stages. It is most frequent in the morning, but may occur after each meal and lead to rapid emaciation. The cough causing the vomiting may be dry.

Nervous cough is often continuous and irresistible, without any intervals between the paroxysms. It usually increases suddenly and often is absent at night, and can last for months with little effect upon the general health. It is dry and high-pitched, and is frequently associated with other nervous symptoms.

The untoward results of cough are numerous and sometimes serious. Involuntary passage of urine is not uncommon in women, but involuntary discharge of the feces is rare unless the sphincter is weakened. Dyspnœa and cyanosis are frequent and emphysema may occur. Pneumothorax and subcutaneous emphysema are both in part the result of cough. Pain in the chest from excessive cough is common and the abdominal wall may become very tender. The excessive exercise from coughing may exhaust the patient, produce profuse sweats and prevent or overcome focal collapse. Hemoptysis due to increased blood-pressure may be traced to cough as well as cerebral congestion and hemorrhage. Hernia, displacement of the uterus, and even abortion may be caused by it. Aspiration of sputum into healthy bronchi may take place during paroxysmal cough. Tachycardia due to severe coughing is more frequent in early than in late stages.

Expectoration. — Few symptoms are more troublesome than this. It is closely associated with cough, and many patients cough simply because they must expectorate. In a few cases from the outset and in many only after much training will the patient allow the sputum to collect just below or in the larynx, when by clearing the throat it can be raised. Bronchorrhœa is sometimes distressing and the patient may be forced to spit day and night. The rales in the trachea may prove very annoying, especially when the patient retires. These often persist, and may be

accentuated as progress is made toward recovery. In a few cases slight expectoration may be the only symptom, and it is not rare to have attention called by hemoptysis to a small quantity of sputum in the morning which contains tubercle bacilli. As the disease becomes arrested the sputum may be the only feature remaining, and it may persist for months or years, and after the disappearance of tubercle bacilli. Destruction of the cords (true and false) renders expectoration much more difficult. If the amount of expectoration is out of proportion to the strength the condition is grave, and when weakness is pronounced it is impossible for the patient to raise the sputum. The relation of the extent of physical signs to the amount of sputum is very uncertain, for patients with slight signs may have profuse expectoration, and *vice versa*. Patients with moderately coarse "moist" rales over an entire chest may be entirely free from expectoration, due to absorption of the secretions in the more normal trunks nearer the roots of the lungs. The latter can hardly take place when the secretion contains tubercle bacilli.

Respiration.—This is usually quickened and rarely falls below 20 or exceeds during rest 30 per minute, except with an acute exacerbation or in far-advanced stages. It is astonishing to see the amount of pulmonary involvement present without dyspnœa except on overexertion, although marked dyspnœa may be present without physical signs. The majority of all patients, however, are short of breath on exertion. Later in the disease, emotion or exertion may produce violent dyspnœa, but orthopnœa is very rare. Patients with a nervous temperament usually have more rapid respiration, and with previous emphysema the dyspnœa is usually greater. Oppression in the chest may be present without dyspnœa.

The cause is most frequently mechanical, due to the involvement of lung tissue and the lessening of the complemental air space. An obliterative pleuritis, or a tracheo-bronchial adenopathy, may produce marked dyspnœa. Serous effusion, accumulating very gradually, and, in a few cases, pneumothorax, cause no respiratory distress. Aspiration of secretions into the air passages may cause pronounced dyspnœa. Dyspnœa seems to be due less to the extent than to the rapidity of the involvement, less to the stage than to the extent of the lesion, and is most pronounced in those cases in which miliary tuberculosis of the lungs supervenes upon a chronic process. Shortness of breath is influenced mechanically by food. In chronic forms, cardiac weakness, palpitation, or thickened pleura may cause pronounced dyspnœa.

Dyspnœa may be *toxic* in origin. With a rise in temperature the rate of respiration is usually increased and the depth diminished, but in many instances this is due to an increase in the pulmonary involvement. Anemia may be the cause in a few patients.

The relation of the respiration to the temperature and pulse is not constant. Cheyne-Stokes breathing is rarely seen except with meningitis. Biot's type of breathing occurs shortly before death.

Hemoptysis.—While often applied to a spitting of blood from any source, hemoptysis is here used to denote a spitting of blood which has escaped into the air passages below the larynx.

Frequency.—It may be said to be present in about 60 per cent. of all cases, but different authorities state from 24 per cent. to 80 per cent. Age has a marked effect upon the frequency. It is rare before puberty, but a fatal case has been reported in an infant of ten months (Hoffnung). In old age hemoptysis is uncommon, but probably more frequent than in infancy and childhood. Sex and age together seem to exert some influence on its frequency. Statistics show that while in males more hemoptysis occurs in the third decade, in females more occurs before twenty and after forty, and more males than females have hemoptysis, and in males this symptom occurs more frequently in the years of greatest activity. There is apparently no connection between height and hemoptysis.

Hemoptysis is an accident which may occur in any form of pulmonary tuberculosis, and is not a sufficient basis for classification. In the more acute varieties it is much less common, but occasionally ushers in an acute process engrafted upon a chronic form. Fowler reported a fatal case in acute miliary tuberculosis, and A. Fränkel one in pneumonic phthisis. Patients with a family history of tuberculosis seem very little more liable than those without this taint. It is unusual to find a patient who has had but one hemoptysis, and some patients, usually those semi-arrested, have a marked tendency to it. Many of them do well, and Andral reported a case in which hemoptysis occurred from the twentieth to the eightieth year. At autopsy numerous calcified tubercles were found in the lungs.

The connection between hemoptysis and physical signs is notoriously uncertain. It may be severe in patients without physical signs, but in these cases calcified tubercles are frequently seen in the radiograph. A fatal case was reported in a child in whom the area involved could be covered by the tip of the finger (Fowler). Patients may have extensive ulceration and large cavities in both lungs without hemoptysis. In sanatoriums it is frequently noticed that it is usual for several patients to have hemoptysis about the same time.

Site and Pathology.—Small hemoptysis, bloody streaks in the sputum, can unquestionably come from the bronchi, but more blood than this comes almost invariably from the pulmonary vessels. Pink and rusty sputum may be due in many cases to diapedesis from the bronchial or pulmonary capillaries, and, while usually not serious, may prove fatal (Fowler). Such sputum, however, is most common after hemoptysis of larger amounts. Some hold that the lumen of the pulmonary vein (more rarely the artery) in some early cases is narrowed by a tubercle in its wall, and that there is a consequent rise of blood-pressure, especially at this point, where the rupture occurs. Fatal hemoptysis from ulceration of a vessel wall without the formation of an aneurism is exceedingly rare.

These *aneurisms* are nearly always found on a middle-sized branch of the pulmonary artery, rarely on the pulmonary vein, and then early in the disease, and more rarely on the bronchial artery. The larger vessels, owing to more elastic tissue, resist erosions, at least until thrombosed. The aneurisms are globular, rarely fusiform, and occur generally

Dobberger (Cam Jr Mu Sc 1925, 1 ; 420) Ht. in due to incr. permeability of the vessel walls. Incr. so in menstruation.

upon the unsupported side of a vessel in the wall of a small cavity, which they may fill. Their size, usually that of a large pea or small cherry, seldom exceeds that of a small walnut, and, while frequently single, they may occur in numbers. Aneurisms may be found in the wall of the bronchus. They are most frequent in the middle area of the lung, near the periphery, *i. e.*, the lower part of the upper lobe (more common) or the upper part of the lower lobe, where the pulmonary movement in respiration is greatest (West). The rupture usually occurs at the distal boundary of the dilatation.

Amount of Blood.—This varies from the slightest trace to several liters, but is usually less than ½ ounce (15 cc.). The blood, usually frothy, may be coughed up by mouthfuls every few minutes for days, or it may come up in a gush and pour out of the mouth and nose and large quantities enter the stomach. In some cases the blood slowly collects in a cavity, finally overflows, irritates the mucous membrane, and is then coughed up. In rare instances with large excavation the patient may die from hemorrhage into the cavity, with little or no hemoptysis. Hemoptyses seldom occur singly, and generally two to four follow each other in the course of five or six days. The sputum is almost invariably blood-stained for several days afterward.

For clinical purposes it is sufficient to classify hemoptysis as streaky, slight (more than streaks and less than 30 cc.), moderate (30 to 100 cc.), severe or copious (100 to 250 cc.), and profuse (over 250 cc.). These amounts refer to the quantity of blood lost in twenty-four hours. In 50 per cent. of all cases the hemoptysis is streaky, in 15 per cent. moderate, and in 10 per cent. severe and profuse. It is an urgent symptom in about 10 per cent. of cases (West).

The blood varies in color from bright red to very dark, depending more upon the time it has remained in the lung than upon its origin. In any case bright red blood cannot be said positively to come from a vein, as the bronchial arteries contain such blood. The blood is rarely clotted at first, although in some instances no fresh blood is ever raised. As the hemoptysis ceases clots are more frequent, and in some cases casts of the bronchi are expectorated. The expectorated blood usually clots quickly and is alkaline. Ortal has found that the blood in some cases possesses the power to agglutinate tubercle bacilli. The bacillary content of the blood varies considerably, but it often contains tubercle bacilli, and in a "primary" hemoptysis should be carefully examined.

The *causes* are intrinsic and extrinsic. The former, the underlying factors in every case, have to do with the changes in the vessel wall. Hemoptysis other than capillary never occurs unless the vessel walls are weakened by disease. In some cases the vessels seem to be hereditarily weak, and these patients may suffer from frequent hemoptysis. Extension of the disease process into the vessel wall usually occurs in the lung, but diseased glands may ulcerate into a vessel and expulsion of lung stones or fibrinous casts seems in some instances to be connected with hemoptysis.

The systemic blood-pressure is much lowered in most cases of advanced pulmonary tuberculosis, but the pressure in the pulmonic system is

apparently raised in many cases and accentuation of the second pulmonic sound is frequent. The frequency of the pulse is often in inverted relation to the arterial pressure. In advanced stages the diminished volume of blood reduces the frequency of hemoptysis. In the majority some rapid increase of pulmonary blood-pressure is held necessary for its production. This is generally thought to be due to some extrinsic, cause, such as violent exertion, particularly of the arms and thorax, or violent respiratory and general exertion. It is singular, however, how rarely hemoptysis follows immediately on any single act of overexertion, and a large percentage (nearly 80 per cent.) cannot be connected with overexertion. Hemoptysis in one group seems to be an accident in the course of the disease, and in the other it is simply one symptom of an acute exacerbation.

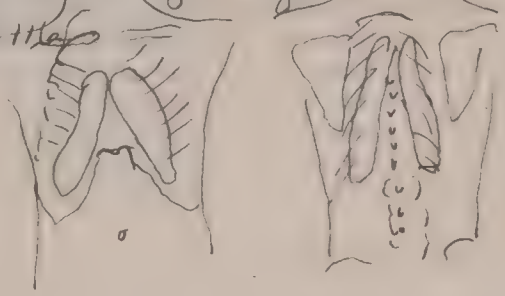
Hemoptysis occurs frequently in the early morning when the blood-pressure in the pulmonary system is subject to marked variations. Some, however, can be traced to prolonged overexertion, but occur many hours later (twenty-four to seventy-two). Emotion and cough stand in a somewhat similar relation.

An attempt has been made to connect hemoptysis with barometric changes, wind, moisture, precipitation, sunshine, and cloudiness, and combinations and quick variations of them; but this has so far failed. It is more frequent (Gabrilowitsch) during the spring and fall, and the sudden thermometric and barometric changes have been adduced as the causative factor. High elevations are said to have no effect upon its occurrence, but patients who exercise immoderately on arrival are more liable to it than in lower elevations. Injudicious use of heliotherapy, natural or possibly artificial, may cause blood spitting. Suppression of blood, from hemorrhoids or from menstruation, has been held as a cause. However it may be, hemoptysis may occur in women about the menstrual period, and some patients have slight hemoptyses every month over long periods. These often have little effect upon the general health, and cease usually when the disease is fully arrested. Coitus may cause hemoptysis (Plique). Irritant gases may be a cause, and one case was observed in which small hemoptyses occurred twice after the administration of ether.

The immediate *effect* of hemoptysis depends upon the quantity of blood lost, the amount of fundamental disease, and the complications. The effect on the ultimate termination is variable, and no matter how severe or how slight hemoptysis has been, it is well to give a guarded prognosis. A slight hemoptysis may be the precursor of a severe and fatal bleeding but as a rule the earlier the stage the less serious the prognosis, which after forty-eight hours is more favorable, as by this time a thrombus can form. In a few cases hemoptysis is followed by some improvement—fall of temperature and loss of feeling of oppression; often this is only temporary. An initial hemoptysis is often of advantage to a headstrong patient who, thoroughly frightened, is willing to take precautions. For this reason it is wise not to pass over an initial hemoptysis lightly.

In a much larger proportion, hemoptysis seems to exert no effect

Unilateral Segmental Myeloradiculitis associated with Herpes Zoster 1924 + 1926



also unilateral-cerebral area in one case

upon the immediate course and appears to be simply an accident. Except a few days' rest it entails no discomfort upon the patient.

In some it has to be considered as simply one of the symptoms of a progressive lesion, with accompanying dyspnœa, rapid pulse, and elevated temperature. In this case the most usual occurrence is an attack of tuberculous bronchopneumonia. Aspiration of the blood into a whole lobe is rare and affects the lower lobes more frequently. The resulting pneumonia may be due to secondary organisms, and be more or less atypical, or to the tubercle bacilli, which is much more serious. The fear and consequent behavior (great agitation and refusal to follow advice) of some patients seem to have a marked influence upon the frequency of this complication.

It is not unusual after hemoptysis to have great dyspnœa, rapid pulse, high temperature, cyanosis, and death in a few weeks from acute miliary tuberculosis of the lungs. Any bleeding followed by one of these four symptoms is to be looked upon as serious, and their absence indicates that little immediate fear need be entertained. Slight fever usually occurs for a day or two, due no doubt to the absorption of exuded blood. Profound prostration may follow the loss of a slight amount of blood when no physical signs are to be detected. A profuse hemoptysis may turn the tide against the patient. It is not infrequent to see in roentgen-ray plates taken some weeks or months after a rather severe hemoptysis, a picture resembling miliary tuberculosis but the tubercles are confined almost wholly to the middle third of the lung field. These patients often do remarkably well.

Death may result from loss of blood, immediately or in a few days or weeks, and comprises about 2 per cent. of all deaths in pulmonary tuberculosis. According to Williams, fatal hemoptysis is nearly twice as frequent when softening begins and nearly five times as common when there is excavation. In some cases the blood pours out so rapidly that death from suffocation follows, the common cause in fatal hemoptysis. Cerebral anemia and syncope are more common causes of death than exhaustion. Death from shock or acute anemia is rare.

Hemorrhage from the lung can take place into the pleura, and some hold that spontaneous hematoma of the pleura is almost always the result of a preëxisting pulmonary tuberculosis.

Pain.—Few patients whose disease runs a more or less chronic course excape thoracic pain. Hawes found it in 84 per cent. of 450 patients. In 1513 patients at the Phipps Institute, Philadelphia, 71 per cent. had some pain, including that referred to the extremities. It may be the first or the most pronounced symptom throughout. The *cause* is very uncertain, and is said to be pleurisy, neuralgia, neuritis, myositis, nervous erethism, pulmonary congestion, pressure from enlarged glands, localized fatigue of the muscles used in respiration or in coughing, extension of inflammation to the intercostal nerves, stretching of the parietal pleura, contraction of old cavities, traction on pleural adhesions or on the heart, pneumothorax, tuberculosis of the rib, as well as to the intrapulmonary disease (the referred pain of Head).

Pain over the upper front is most frequently referred or due to acute

pleurisy or to traction on pleural adhesions. Pain over the base of the lung is usually pleuritic, while pain in the interscapular area may be referred, due to pleurisy or to pressure from enlarged glands. Pleurisy is not always accompanied by pain, as the friction can at times be heard several feet from the patient and cause little or no discomfort, but pulmonary tuberculosis is practically always accompanied by pleurisy, and it is an exceedingly rare thing to find no pleural adhesions at autopsy. Pleuritic pain may be severe or slight, may occur only after a deep inspiration, expiration, cough, sneeze, or yawn, or may be continuous and every breath be attended with pain. This pain varies from a vague discomfort, a sense of pressure or of tension, to a sharp, lancinating pain which cuts the breath short and produces sweats and great prostration. It may occur in any part of the chest, but is most frequent in the interscapular, subclavicular, and infra-axillary regions. The pain may be noticed upon the opposite side, in the epigastrium, the hypochondrium, the sacrum, the shoulder on the affected side, and even radiate down the arm (diaphragmatic pleurisy). Singultus is not frequent. Slight pleuritic pain is often accompanied by a short, hacking cough and fever. A sudden cessation of pain suggests fluid.

Patients often complain of pain that cannot definitely be said to be due to pleurisy, and in many cases is no doubt the referred pain of Head. The site varies, but it usually occurs on the affected side. The most common locations are the infraclavicular area to the third rib, the interscapular and the infra-axillary regions. Pain also occurs, but less frequently, at the apex, in the suprascapular and subscapular areas, and may radiate down the arm, in some cases in which angina pectoris is suspected from the localization of the pain. The character of the pain is very variable, being most frequently a slight feeling of discomfort, of localized fatigue, or soreness. It may be constant in location and time and last for days, months, or even years. It is most frequently fleeting and difficult in some cases to localize. The pain in some instances escapes the patient's notice until percussion is done. In other instances deep pressure is necessary to elicit it, and again the skin may be so sensitive that the slightest touch causes severe pain, the clothes cause great discomfort, and the patient lies on the opposite side. In these cases of hyperesthesia the skin is often very sensitive to pressure between the fingers. At times the pain is described as going "through and through." In many cases the pain is independent of the respiratory movement, in others it is increased on any unusual movement, and is frequently noticed only on coughing, yawning, or sneezing.

Pain often precedes hemoptysis and may disappear on its occurrence. Intercostal neuritis with the classical points of tenderness is rare. An intercostal myositis has been described by Coplin and by Aufrecht. Louis attributed the pain in some instances to tubercles in the lungs, and Andral the pains which appeared with fever to the softening of tubercles, but the only pains connected with the pulmonary parenchyma are the referred pains of Head. Severe pain from herpes zoster (before the eruption of the rash) or from pneumothorax (when many adhesions are present) may not be attributed to the proper cause for some days.

Pain about the thorax, over the insertion of the diaphragm and in the abdominal and dorsal muscles due to cough, is not uncommon.

Voice.—Changes of the voice are frequent. The slight "prodromal" hoarseness, often temporary and fleeting, but recurring, may be the first indication of pulmonary disease. The larynx may be normal. In advanced stages the voice often becomes weak, is easily fatigued, and on prolonged use may disappear. Excluding tuberculous laryngeal changes the cause of the hoarseness has been attributed to nervous conditions, neuritis of the laryngeal nerves, atrophy of this nerve (more commonly of the left, due to pressure from pleural thickening, apical contraction, enlarged glands), laryngeal catarrh, straining from severe cough, and collection of irritating sputum upon the cords.

THE PHYSICAL SIGNS OF PULMONARY TUBERCULOSIS

The chief importance of these relates to diagnosis. To a limited extent the physical signs vary with the time of day, especially in some advanced cases in which rales may be present only early or late in the day or heard only when the patient is recumbent. It should never be forgotten that extensive lesions, situated centrally, may produce only very slight or even no physical signs. Repeated examinations may be necessary to discover all the physical signs present at an early stage.

Inspection.—The patient, stripped to the waist, and covered with a chest cloth or blanket, should be in a warm room, either sitting (preferably on a revolving stool) or standing, so that a strong light falls diagonally across the chest, which should be viewed anteriorly, posteriorly, laterally, and from above.

Shape.—The general conformity of the chest varies from the normal to the most pronounced paralytic or phthinoid type. The shape seems to bear some relation to the stage of the disease and is a trifle long at first, with a slight prominence of the clavicle on the affected side. As the disease advances the chest becomes slightly smaller, due probably both to emaciation and change in bulk of the lungs. In unilateral disease the change in bulk of one lung may be compensated for by enlargement of the sound lung without any external manifestations.

The *flattening* of the chest so often seen in the late stages is in most cases more apparent than real, as can be easily observed by having the patient stand or sit erect and hold back his shoulders. In some instances this demonstrates a chest rounder and deeper than normal. The round chest with the falling forward of the shoulders often causes tilting of the scapulæ, the so-called "winged" scapulæ. The costal cartilages may be raised and the sternum depressed, forming in accentuated cases the "funnel" chest. The paralytic thorax is more often a result than a precursor of pulmonary tuberculosis, and may occur in other diseases. Changes due to intrapulmonary disease are most likely to be seen at the apex, those due to pleuritic disease at the base (except in children).

Asymmetry, absent only at first, is later often very marked and is best observed by comparing the clavicles. Shrinking below, more import-

ant than above, the clavicle is in part at least due to atrophy of the pectoral muscles. In pronounced cases the shoulder on the affected side is lower. Pottenger holds that atrophy follows prolonged spasm. Bulging or undue prominence of the affected side may occur. Plate-like depressions or dimples in the inner first, second, and third intercostal spaces, due to old fibrous infiltrations or cavities, are not uncommon and the inspiratory movement of the anterior border of the right lung, when it has undergone compensatory enlargement, may be seen by a bulging of the left intercostal spaces for ½ to 1 inch from the sternum, while the rest of the side remains almost or quite motionless (Turban). Bulging of the interspaces otherwise occurs only when some complications arise. Tilting of the clavicle on the affected side has been described in early cases.

The area of *visible cardiac impulse* increases as the lung contracts and the point of maximum impulse may be in the left anterior axillary line, in the right mid-clavicular line, or even under the angle of the left scapula (Kidd). Cavity and more rarely pleurisy produce such marked changes. A large area of cardiac impulse in the second, third, and fourth interspaces on the left usually indicates disease of the left apex. Displacement of the absolute cardiac dulness ¾ or 1 inch to the right is typical of right apical disease of some standing.

Movement.—Limitation occurs early, and a unilateral limitation or lagging may be one of the few signs present. In a majority of cases lessened movement occurs first in the subclavicular fossa, and can be readily seen from in front. In other instances the limited excursion can be observed more readily by standing behind the patient seated on a stool and placing the hands over the subclavicular fossæ. As the disease advances the limitation of movement is more marked, and in some cases probably through the calcification of the cartilage, the chest moves only as a whole. Litten's phenomenon yields little information. Local retraction of the chest may occur during inspiration, due probably to pleuritic changes. When the normal wave-like elevation of the first three ribs, beginning at the first, is absent, some pathological change has occurred in the lungs (Hoover).

Limitation of movement is due (1) to obstruction of the bronchi and deficient entry of air; (2) to change in elasticity of the lung through consolidation or fibrosis; (3) to pleuritic adhesions or pain; (4) to calcification of the costal cartilages; (5) to weakness; (6) to muscle spasm.

Venous varices are frequent near the costal margin, usually equally upon the two sides. The subcutaneous veins over the upper chest may be dilated, often on one side, probably due to constriction of the intercostal veins through pleuritic inflammation and return of the blood through the anastomotic channels to the superficial vessels.

A *difference in the size of the pupils* occurs at times and the larger pupil is usually on the same side as the lesion, due no doubt to pressure on or involvement of the cervical sympathetic system.

Mensuration.—The *circumference of the chest* is best measured in the plane of the junction of the fifth costal cartilage and the sternum. It should be taken during quiet respiration, at the postexpiratory pause, and after a deep inspiration and full expiration. Confusion exists in

regard to the terms "chest expansion" and "respiratory movement." The former should be used to indicate the difference between quiet respiration and full inspiration. The normal expansion in health is about $1\frac{3}{4}$ inches for males, $1\frac{1}{2}$ for females, the normal respiratory movement more than double these figures. Patients who have taken respiratory exercises, or who walk up graded paths, have larger measurements than those at

British Medical Journal,
Nov. 21, 1925, page 76

Antimony Tartrate in Haemoptysis.

Mattéi and Escudier(Journ. de Méd. et de Chir. prat., Sept. 25, 1925, p.680) report the successful treatment by antimony tartrate of eleven cases of haemoptysis, when other measures had failed. Pills containing 1/2 or 1 gr. of this salt, together with 1/6 grain of the French extract of opium, were taken in a spoonful of water. The daily dose varied from 1 to 3 grains, given continuously for ten days, the total dose amounting thus to 17 to 30 grains, which involved no risk of poisoning. In five cases a single dose of 1 grain arrested a grave haemoptysis; in the remaining six cases one dose of 1/2 grain was followed within twenty-four hours by the reduction to slightly stained sputum of haemoptysis which had ranged from 14 to 70 ounces. Haemoptysis usually stopped after preliminary nausea, although this did not always occur. The lowering of the

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blood pressure was not regular and did not last longer than the nausea. The authors attribute the favourable effects of antimony tartrate upon haemoptysis to the production of a vasomotor reflex of gastric origin, to the depressor action of the drug upon the right ventricle, or to its direct influence upon the pulmonary vasomotor nerves.

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British Medical Journal,
Feb. 9, 1929, p. 23.

Bimanual Palpation of the Thorax

A. Savulesco (Bull. et. Mem. Soc. Med. des Hup de Bucharest, Nov. 1928, p. 336) suggests a new clinical method for the observation of local fremitus. While these are usually easily palpable in men, they are often diffucult to detect in women, children, and those who have soft voices. If one hand is placed is placed on that part of the anterior aspect of the chest which is to be examined, and the other is pressed over the corresponding area posteriorly, vocal fremitus is greatly magnified. By this means vibrations may be felt in patients who show none by other methods. The author illustrates his technique by describing two cases. In the first, a young woman at the onset of pneumonis, no fremitus was felt until the bimanual method was applied and this revealed diminished vibration over the area in which tubular breathing subsequently developed. The second patient, a boy

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with a penetrating wound of the thorax, had several rigors ten days after his injury. No vocal fremitus was elicited anywhere over the thorax until bimanual compression was tried, when it was felt at all areas except at the right base. The presence of fluid was thereby indicated, and subsequent exploration revealed an empyema.

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American Journal of Medical Sciences
Aug. 1928, p. 287. v.176.

Endotracheal Application of Adrenalin in the Treatment of Pulmonary Hemorrhage.

Giuffrida(Munchen. med.Wchnschr.,1928, 75,302) has employed adrenalin solution by direct instillation into the trachea, after preliminary anesthetization of the pharynx, for the control of hemoptysis in 50 patients suffering from pulmonary tuberculosis. In 2 patients it was not possible, successfully, to introduce the adrenalin into the trachea. In 3 others although the intorduction was successful, the bleeding was not controlled. In the remaining 45 hemorrhage was checked more or less promptly. All these 12 were completely controlled by a single injection and 33 required repeated applications over a period of several days, in order to effect complete stoppage of the hemoptysis. The hemorrhage was checked immediately in 15 cases, while in the remainder it ceased within a short time after the application of the adrenalin.

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The control of bleeding lasted for 12 hours in the majority of patients and it was found necessary to repeat the administration of adrenalin, in most cases, at intervals of about 12 hours for two or three days, in order to make sure of permanent control. The dose employed was 1 cc. of the 1 to 1000 solution, diluted with twice as much water, in order to provide a volume sufficient to spread over a considerable area in the bronchial tree. The author points out that it is necessary always to emply a potent preparation of adrenalin since this drug frequently deteriorates and weak specimens fail to produce the desired effects. Along with his use of adrenalin in this manner, he made observations on the patients' blood pressures at varying intervals of time, following its intratracheal injection. In no instance was he able to observe any elevation of the patients' systemic blood pressures.

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The *length of the chest* in many far-advanced cases, especially those with a phthinoid or paralytic thorax, is considerably increased.

Chest Index.—This is the relation of the antero-posterior to the transverse diameter at the level of the junction of the fourth or fifth costal cartilage with the sternum. In health this may be stated to be 73, in early stages of the disease about 72, and in later stages about 76; it has no prognostic and little, if any, diagnostic value. There is some tendency for the chest to divide into two types, one flat (index 68 to 70) and one deep and round (index 78 to 80), but both slightly reduced in size and longer than normal. Freund called attention to the early calcification of the first costal cartilage, and Gessner attempted to measure the superior aperture of the thorax, applying the laws governing the relation of the external to the internal pelvic dimensions. He finds "relatively often" a stenosis, more marked in the more acute types.

The lead-tape *cyrtometer* used in conjunction with accurate calipers will give a reliable outline of the chest, which recorded on paper can be used for comparison with future tracings. Many patients undergoing treatment show marked increase in size of the thorax. The pantograph, which produces an exact tracing of the shape of the chest in any size desired, is theoretically valuable, but practically of little use.

Spirometry has not proved of much value, as many early cases show little change; but used over an extended period may aid in the prognosis of an individual case. Dreyer of England and Meyer of Minneapolis have advocated the use of the vital capacity corrected for trunk length, weight, occupation, circumference of the chest, and body surface in diagnosis but Heise and the writer have found it of slight value. A sudden and marked reduction may indicate a new focus.

Pneumatometry.—Waldenburg's study of the inspiratory and expiratory forces seems to show that the inspiratory power is diminished even in incipient pulmonary tuberculosis, while the expiratory (except in extreme cases) remains normal. The reverse is true of asthma, emphysema, and bronchitis, but the diagnostic value is slight.

Palpation.—This with inspection affords the best means of determining unilaterally restricted movement. To palpate the apex it is best to stand behind the patient, and placing the thumb in the supraspinous and the fingers in the supraclavicular fossa, grasp the apex, so to speak, in the hand. The vocal fremitus is in many early cases little if at all changed from normal. In more advanced cases great discrepancy exists at times between signs discoverable by palpation and signs obtained by other procedures. Vocal fremitus may be increased or absent over a cavity. Pleuritic friction and sonorous rhonchi are rarely palpable. Markedly increased vocal fremitus usually indicates consolidation.

Tussive fremitus may be of value in aphonia. Tenderness may be complained of on palpation, but is usually elicited on percussion.

Percussion.—Methods.—With the chest bare, the patient should stand or sit in a corner or near a wall, with his arms hanging loosely by his sides and his head straight. It is best to begin with immediate percussion of the clavicles. Often when percussing one side it is well to go from the resonant parts below to the suspected apex. In some cases the supraclavicular fossæ can be percussed more accurately from behind. If in doubt the part should be percussed after a full inspiration, first from one side, then from the other. To percuss the axillary region the patient should clasp his hands above his head or place them on the back of his neck and raise his elbows as far as possible.

Direct percussion in many instances is helpful, especially when comparing the note of the bases behind or the clavicles. Auscultatory percussion is of little value except in defining the limits of the lobes. Light percussion is usually best but heavy may reveal lesions 5 cm. or more below the surface of the lung which, even if extensive, may escape detection. When the involvement of pulmonary tissue necessary to produce any change in the percussion note is considered the absence of dulness in the minimal stage is not strange.

In some cases the first change in the percussion note is a shortening of the duration, although in many cases it is already accompanied by a rise in the pitch and a diminution of the loudness. Occasionally, emphysematous changes occur which mask the dulness even in some quite advanced cases. This change is no doubt the cause of the slight relative dulness at times detected on the apparently unaffected side.

In many cases on careful percussion a slight change in note is detected at the level of the second rib. If we percuss from below upward, at this level, the note becomes slightly higher in pitch and possibly a little shorter. This is not pathological, but is due to the increased thickness of the pectorals in these areas. Slight dulness may be found in the interscapular region (enlarged glands?) in some patients without any other abnormal physical signs. Scoliosis or irregular configuration of the shoulder may cause slight dulness and apparent shrinking. Percussion over the vertebræ is not of much aid in apical dulness.

The *dulness* observed in incipient pulmonary tuberculosis is usually very slight, often requires much experience to detect, and frequently increases as the patient recovers. In more advanced cases, and especially in those whose onset was with pleuritic effusion, the dulness may be very marked and pass even into flatness. Advanced tuberculosis may exist, however, with little or no change of note. Tympany or hyperresonance may occur when small foci compress the intervening tissue, when emphysematous changes have taken place, or with cavity or complications (pneumothorax). The *cracked-pot sound* may be heard more frequently on the left side, over cavities, possibly superimposed (Walsh), with an elastic wall situated superficially in the upper anterior part of the upper lobes. It is nearly always, when pathological, associated with some degree of dulness, and is rarely obtained elsewhere than in the region between the clavicle and the fourth rib.

Increased resistance is associated with different degrees of dulness in many cases. Percussion may elicit tenderness, usually more marked on the side more affected. It is always advisable to determine by percussion the lower level of the lungs, as small areas of dulness in this region are readily overlooked. Lessened excursion of the diaphragm, frequent on the affected side, can be determined by percussion of the bases of the lungs at the end of full inspiration and expiration.

Krönig has suggested that the resonant areas above the clavicles be mapped out and these areas compared. A slight change in position is of little consequence, but a difference in size or in the sharpness of their definition is suggestive of disease. Very light and moderate percussion should be used alternately in mapping them out. It is well to begin on the clavicle and along the border of the trapezius muscle and then to connect these points. Other suggested methods are not so simple as this. It is, however, little used today.

Auscultation.—The first abnormal physical signs in pulmonary tuberculosis are those detected by auscultation, but even these may first occur months after the pulmonary infection. The patient should be stripped to the waist. Special attention should be paid to the borders of the lungs. He should be made to breathe noiselessly through the mouth whenever loss of vesicular murmur occurs at both apices. This will exclude in some instances a "loss" of vesicular murmur due to exaggerated transmission of the breath sounds from the nasal region due to obstruction. A series of short, quick inspirations often aids in demonstrating a good vesicular murmur in superficial "breathers." The breathing is usually more pronounced to the second rib and third vertebral spine on the right, and below the eighth vertebral spine on the left side. Broncho-vesicular breathing occurs normally to the second rib and third vertebral spine on the right, and opposite the seventh vertebral spine on the left, due in the first case to the closeness of the right apex to the trachea. In persons who have never breathed properly the vesicular murmur may be weak on quiet respiration.

Changes may occur in the quality of the vesicular murmur, in the relative duration of its two parts or in the pitch, continuity and equality. The first change is often some harshness and increased loudness. This in most cases is constant increase of loudness or elevation of the expiratory murmur—prolonged high-pitched expiration. Grancher held that the earliest change is a constant weak, harsh, or wavy inspiratory murmur, due to an inflammatory swelling of the lining of the terminal bronchioles, which if sharply defined at one apex is very significant. Wavy breathing precedes weakened breathing, which probably occurs only when the area of infiltration has reached some size. A change in the vesicular murmur is often the only variation from normal. In many cases it is difficult to define this slight change. The breathing is usually more pronounced at the base on the side on which the patient is lying, less so at the apex.

Wavy, Jerky, or Cogged Breathing. Sometimes the inspiratory vesicular murmur is not continuous, but "wavy." In pronounced cases the breathing is not heard for a time, and reappears and disappears several times

in a single respiratory act. This has been termed cog-wheel or jerky breathing. Such breathing may be due to forced inspirations, and heard only when such are taken. Under such circumstances it is usually muscular in origin and has no significance. In early stages it does not often occur over the site of the lesion but when heard at the apex it is always suggestive, and a patient with it should be looked on with suspicion. Wavy breathing over both sides is frequent in nervous patients and is no indication of disease. It is frequently heard at the base behind, especially on the left side.

A spluttering type of breathing, suggesting that rales are about to occur but never do, has been called granular breathing and is rare.

Prolongation of Expiration.—The first change to be detected by auscultation in some cases is a prolongation of the expiration, often slightly raised in pitch, due to a constriction of the bronchioles.

Weakened Breathing.—Weakened or distant breathing at one apex is often very suggestive. It may be due to extensive and numerous foci, to pleuritic changes, or to the narrowing of a bronchus by pressure or mucus which may be removed after coughing. In other instances, only after some days is the breathing of normal or increased strength. Feeble musculature causes weakened breathing throughout both lungs.

Puerile and Harsh Breathing.—This is also rather infrequent in early stages, and while found frequently on the unaffected side in advanced stages it is by no means an unfavorable sign, as in many instances it indicates compensatory action.

The "metamorphosing" breathing is that form in which a change from a high-pitched to a normal vesicular quality, or *vice versa,* occurs during inspiration. It is said to be pathognomonic of pulmonary tuberculosis, rare in occurrence, and due to a partial and momentary constriction of a bronchus by mucus.

When the disease becomes fairly well-marked the vesicular quality loses its pure tone and becomes more or less bronchial, the type of breathing most common in pulmonary tuberculosis, and spoken of as broncho-vesicular or vesiculo-bronchial breathing.

Vocal Resonance.—The vocal resonance often varies directly with the vocal fremitus and, like the latter, is more pronounced on the right, to the level of the second or third rib and third vertebral spine, or even lower on the back as the right apex lies directly against the trachea while the left is separated from it by bloodvessels. A slight increase on the right is therefore difficult to detect. The whispering voice as well as the ordinary tone should be very carefully auscultated over the entire chest, as small or deep-seated areas of consolidation are often first detected by this means. As the disease advances the vocal resonance passes through various gradations into bronchophony, and when excavation occurs whispering pectoriloquy is an important sign. An increase of vocal resonance with a decrease of vocal fremitus, indicates usually a pleural overlying a pulmonary change.

Adventitious Sounds.—*Rales.*—It is rare to detect any adventitious sounds in the lungs in minimal pulmonary tuberculosis on quiet breathing. When rales are detected on quiet breathing the case is usually

Laines: W. med W. 1926, 16: 119. Head to extent of examines to say, no, ray, Set incr. if ord. get. less in pBs. ē children of insane.

no longer in the minimal stage. *Rales are in most patients in minimal stages heard only during forced inspiration following cough, and may not be constant.* It is often necessary to explain carefully—best by example—to the patient how to cough in order to bring out clearly any adventitious sounds. He should be directed to cough with some force as noiselessly as possible and immediately after it to take a full, fairly rapid inspiration, contracting his muscles and moving his shoulders during the whole procedure as little as possible. In certain cases a cough at the end of expiration followed by a full inspiration brings out rales heard in no other way. In some instances the rales are heard only on quiet breathing, in others they disappear after the first deep breath.

All varieties of rales are heard in pulmonary tuberculosis, but fine and moderately coarse are the most frequent. Resonant (consonating) rales occur over cavities, but may be present where no other signs of cavity exist. Gurgling rales indicate bronchial dilatation or cavity formation. While in early stages only a few fine rales, or a localized rhonchus, whining in character (Turban), heard with difficulty after coughing, above one clavicle, may be present; in advanced stages rales may be so numerous and so loud that the breath sounds are completely obscured. The "mucous click" is common in advanced pulmonary tuberculosis and is said to indicate softening.

Rales are most frequently heard first above or below the clavicle, slightly more often on the right side. The supraspinous area is often early involved and should be carefully examined. Very often a few rales, fine or moderately coarse, are heard after coughing at the bases (marginal sounds), and are of slight diagnostic significance. In some instances rales are heard only when the patient is in a reclining position.

Pleuritic friction, except that variety simulating intrapulmonary rales, is rare in early stages, possibly because of the apical location. Moderately coarse, superficial rales may be heard over the entire chest with absence of all sputum. This can be explained in two ways: First, that the sounds are of pleuritic origin; second, and more probable, that the secretion is absorbed. Creaking and rubbing sounds, believed by many to be produced in the lungs, are difficult to separate from pleuritic friction sounds and deep-seated rhonchi.

Cardio-respiratory murmurs are frequently mistaken for pathological wavy or interrupted breathing. If they occur at the left base with no other signs of disease, any connection with pulmonary disease can be excluded. Wide transmission of the heart sounds indicates a very forcible beat or beginning infiltration of the pulmonary tissue.

Post-tussive suction, a peculiar high-pitched, sucking sound occurring during the first part of inspiration following cough, is heard not uncommonly over cavities. It does occur, however, when no other signs of cavity exist. The *veiled puff* is a "single, rather high-pitched sound, of a puffing character, which becomes suddenly audible toward the end of inspiration" (Fowler). It is said to be a valuable sign of a small sacculated bronchiectasis.

Roentgen Rays.—In the last decade the most important addition to physical examination of the lungs has been the roentgen-rays. In fact

a grave danger today is the tendency of many physicians to rely almost entirely upon roentgen-ray studies. It should always be borne in mind that certain areas of the lungs, lying behind or in front of the heart or deep in the lung and close to the heart, do not yield satisfactory roentgen-ray information in some early cases. In a few cases tubercle bacilli occur in the sputum when it is impossible to diagnose tuberculosis from stereoscopic plates. Consequently the former methods of physical examination can never safely be neglected by anyone who desires to diagnose early pulmonary tuberculosis. On the other hand, while the early lesions often lie below the clavicle and above the third rib and third vertebral spine, they do not always reach the periphery of the lung and hence give indefinite or doubtful signs. In the vast majority of these deep-seated lesions the roentgen-ray is of invaluable help, and in at least one-half of all cases furnishes evidence that the lesion is more extensive than the physical signs indicate. Hence it is never safe to exclude pulmonary tuberculosis in any person until a careful roentgen-ray study has been made. Definite roentgen-ray changes rank next to tubercle bacilli in the sputum and moderately coarse rales in the lungs.

It should never be overlooked that roentgen-ray ~~plates~~ are shadowgraphs, and consist of many superimposed shadows. Stereoscopic ~~plates~~ often separate these masses of confusing shadows and relegate them to different planes. For this reason such plates often enable one to decide that doubtful changes on a flat ~~plate~~ are of no significance. To accomplish this, the ~~plates~~ must stereoscope well, must be free from the haziness produced by movement or by breathing, and must be neither too dense nor too delicate. The changes in pulmonary tuberculosis are usually found above the third rib and third vertebral spine, and consist typically of larger or smaller masses of fine or gross mottling irregularly distributed. In a few cases the mottling is apparently distributed along the course of the trunks and is called peritruncal tuberculosis. Most of such mottling, however, cannot be said to be due to tuberculosis. On the other hand, the irregular mottling has been termed parenchymatous, indicating that the parenchyma of the lung is more widely involved. To be significant it must occur above the third rib and third vertebral spine. Such changes occur in 95 to 98 per cent. of all patients with tubercle bacilli in their sputum. While a diffuse cloudiness may be due to tuberculosis it is more often pleural or due to non-tuberculous processes.

In children before the seventh year the pulmonary disease often begins in or about the root and can be diagnosed only by exclusion or by waiting until the parenchyma of the lung is definitely involved. Great care should always be exercised in diagnosing "mottling" near the root as tuberculous at any age.

Fluoroscopic examination yields important information about the movement of the diaphragm, heart, etc., and reveals gross lesions which occur in pronounced cases but it is of slight or no value in the detection of the finer early changes. In determining the time for and controlling the amount of refills in collapse therapy it is of much help.

Certain annular shadows which cut off more ray than the surrounding lung, which at varying intervals enlarge and decrease in size, have been

s vs plural bibles (mills)

considered by some to be pleural manifestations and not intrapulmonary cavities, in which more ray passes through the annular shadow than through the surrounding lung.

Latent Pulmonary Tuberculosis.—Physical signs may be entirely lacking. "Closed" pulmonary tuberculosis belongs here—"closed" because tubercle bacilli are not found (ulceration or "opening" of the focus has not occurred). In a majority, however, slight suggestive physical signs are present, though taken alone they may not be sufficient for diagnosis. A percussion note a trifle high-pitched and short above the clavicle, localized increased resistance, a shrinking of the resonant area above the clavicle, lessened diaphragmatic movement on one side, a slight deficiency in the vesicular murmur, and possibly a few fine rales clearing up on coughing are the most common signs. Any one of these may occur alone. In other words, the physical signs in this stage are often simply suggestive and suspicious and indicate further investigation. The so-called "pretuberculous" stage often belongs to this group. Well taken stereoscopic roentgen-ray plates are often indispensable for diagnosis.

Early (Incipient or Minimal) Pulmonary Tuberculosis.—The physical signs are more pronounced; there is lessened movement at one apex, with slight dulness, a few fine or moderately coarse rales, heard usually only during the inspiration following cough. The change in the vesicular murmur is more marked and, besides high-pitched prolonged expiration, the inspiration may be changed and broncho-vesicular breathing may occur. Wavy or weakened breathing may be present. The vocal fremitus and vocal resonance are both likely to be increased. In other words, persistent signs of local bronchitis at one apex are usually the first positive physical signs, although others are quickly added.

Advanced Pulmonary Tuberculosis.—All physical signs to be detected in the lungs may be heard at one time or another in advanced cases. One apex may present very early signs, while the other is in an advanced stage. In any case, however, the "physical signs" usually refer only to the most advanced lesion in the lungs. In rare cases either dulness or rales may be entirely absent. Hyperresonance may occur.

Softening.—The physical signs of "softening" are very uncertain. An increase in the size of the rales and a metallic quality or ringing character are said to indicate softening as well as the moist or dry crackling. The condition of the surrounding tissue modifies many of these physical signs. The signs of softening are often those of early cavity formation.

Signs of Cavity.—These depend largely upon its size and location, and the condition of the surrounding tissues. Cavities of fairly large size may be readily overlooked either because a stoppage of the bronchus prevents the entrance of air, or because the cavity is filled with secretion or deeply situated. Unless superficially placed or surrounded by consolidated lung tissue, it is not possible to diagnose cavities smaller than a walnut. Except in acute pulmonary tuberculosis, cavities may be assumed to be present practically always in the last stages, but often are discovered only by roentgen-ray or at necropsy.

Inspection in no way differentiates cavity formation from fibrosis. In some rare instances more local bulging and retraction than is usual occur in a limited area on coughing. The note over a cavity may be normal, dull, flat, *tympanitic*, or amphoric. Change in tone may occur with change of position (change in position of liquid contents, etc., Gerhardt), with opening (higher note) or closing (lower note) the mouth, *i. e.*, mouth breathing (Wintrich), or with respiration (higher during inspiration), and may disappear if the tension of the wall is very great (Friedrich). These are of little practical value. Change of position, leading to occlusion of the bronchus by the fluid contents, may obliterate many of the signs of cavity or lead to its diagnosis by emptying the cavity. The *cracked-pot* note is frequent over superficial cavities with a narrow opening into a patent bronchus situated in the upper lobe anteriorly between the clavicle and fourth rib, and is rare in cavities elsewhere. On auscultation the respiratory murmur may be intense, distant, or even absent, but is usually tubular, *amphoric*, or *cavernous*. While auscultating a cavity the cavernous breathing may be quickly replaced by tubular breathing, to yield in turn again to cavernous breathing. The metamorphosing breathing of Sietz may occur.

Coarse, gurgling rales are most characteristic of large cavities partially filled with secretion. Sharp, ringing, metallic rales are more frequent in smaller cavities, and may be heard only after cough. In old cavities, hisses, creaks, sonorous and sibilant rhonchi may replace all other rales, and in a few cases there may be no rales. The metallic tinkling sound occurs but rarely. The veiled or especially the cavernous puff may occur. Post-tussive suction is frequent. Clicks or gurgling sounds may be heard over cavities in the left upper lobe synchronous with the heart impulse. The voice sounds over a cavity are usually much increased, bronchophony, often amphoric or cavernous, practically always occurring. *Whispered pectoriloquy*, of low pitch and blowing quality; is one of the most trustworthy signs of cavity. In cases with a chronic cavity the area of cardiac impulse may be greatly increased, and in some instances with cavity on the right side the point of maximum impulse may be as far out as the right nipple line. Hippocratic succussion and the coin sound may be heard over large cavities, and in some instances pneumothorax has been diagnosed. The physical signs of an apical cavity may completely disappear in front and be heard only at the apex posteriorly, or more rarely disappear entirely. A dislocated trachea may give many of the signs of apical cavity. A cavity may be overlooked if the patient is not made to cough and so remove a plug of mucus in the bronchus leading to the cavity. On roentgen-ray examination, cavities if not surrounded by too thick a layer of diseased lung appear as light areas.

Attention has been called to a group of annular shadows which simulate intrapulmonary cavities but less roentgen-ray passes through them than through the surrounding pulmonary tissue, and at times they vary greatly in size or may disappear. Some claim they are either pulmonary cavities or superimposed shadows. Much evidence can be adduced to show that they are at times pleural in origin. Unquestionably many cavities occur which are revealed only by roentgen-rays or autopsy. An

W. S. Miller (Am. Jr. Roentgenology 1926, 15; 394-407) Annular shadows are probably blebs, just under the pleura, due to giving way of elastic fibres joining pleura to underlying lung & breaking & some air passing outside.

appearance like a honey-comb or bit of bread may indicate a fine cavity formation.

Signs of "Activity," "Arrest," and "Cure."—It is often impossible to tell from a single examination whether the disease is progressing or retrogressing. The physical signs may suggest great activity when the disease has been inactive for months. The contrary is also true.

Lungs once affected with tuberculosis are seldom if ever "cured" in an anatomical sense. Some patients with incipient disease after months present no physical signs, but few of those in advanced stages recover without pulmonary scars detectable by physical examination (*e. g.*, signs of consolidation, emphysema, etc.). It is remarkable what extensive physical signs may be found in patients who have enjoyed years of good health who may go on to permanent arrest and remain well for years with no diminution of the physical signs. Most patients present slight retraction of an apex or base, some dulness on percussion and loss of vesicular murmur which may even pass into bronchial breathing. Pleuritic sounds may linger in various regions, but it is questionable how soon a patient with rales over any extent of the chest can be said to be "cured." In a series of several thousand stereoscopic pulmonary roentgen-ray plates, only four or five showed complete disappearance of all pathological changes (Sampson).

Myoidema.—This occurs in two forms, nodular and fibrillar or fascicular. In the minimal stages myoidema is usually absent. It may occur only one one side or more on one side (usually the side affected) than on the other, and may disappear as a fatal termination approaches. It has little importance, but when present demands a careful general examination of the patient, especially of the lungs.

Hippocratic Fingers.—These are usually a late manifestation in cases of long standing. The toes are often affected and the nose may be involved.

Hypertrophic Pulmonary Osteo-arthropathy.—This is rare in pulmonary tuberculosis. The small joints of the hands and feet are usually affected, but the wrists, elbows, and rarely the hips and shoulders may be involved.

THE MODES OF ONSET OF PULMONARY TUBERCULOSIS

The exact time of onset, except in acute cases, can rarely be definitely determined. In a large majority, signs of failing health long precede symptoms localized in the lungs. Only a careful inquiry brings out these facts, which seem in many instances to have entirely escaped the notice of the patient. For this reason the onset in regard both to time and to symptoms is difficult to determine exactly. Many have at the onset or early in the disease some symptoms or group of symptoms which characterize the disease at first and enable us to divide them into several groups, which are not sharply differentiated and often combined.

Insidious or Latent.—Careful inquiry often reveals symptoms of ill-health preceding for weeks, even months, the so-called "primary" hemoptysis, pleurisy, or acute febrile attack. The patient begins gradually to run down in health; he tires more easily, has less strength, loses a little

weight and has slight fever in the afternoon; his appetite is poor, and if he lives in certain localities, is told he has a "touch of malaria." Undoubtedly many recover at this stage, which throws more obscurity about the recognition of this type of onset. This latent group undoubtedly includes a large majority of all cases if a careful history is taken. In some instances serious disease in other organs masks the onset of pulmonary tuberculosis. The importance of the recognition of this group cannot be overestimated, for in early recognition lies cure.

Glandular.—Research has shown that the bronchial glands may be affected shortly after the cervical, and that tuberculous disease of the bronchial glands is closely associated with—some hold an almost constant precursor of—pulmonary tuberculosis. As a rule, only cases with marked glandular involvement or suppuration should be included in this group. The existence of a few slightly enlarged cervical nodes does not constitute a "glandular" onset.

Fistula-in-ano.—In a number of cases a suspicion of pulmonary tuberculosis is aroused by an ischiorectal abscess with a resulting fistula. The lungs are found tuberculous, but in many instances the symptoms were so slight that they drew no attention to the lungs.

Catarrhal.—This is unquestionably the most frequent. A large majority of patients give a history of repeated colds, an attack of slight persistent bronchitis, or of "grip," as the earliest symptom. Many of these attacks may light up a slumbering tuberculous lesion. In some instances this onset closely resembles an attack of asthma. A history of cough during the winter for several years is not uncommon, and its persistence during the summer may first arouse the patient's anxiety.

Pleuritic.—Unquestionably, it is wise to treat all cases of idiopathic pleurisy with effusion as tuberculous, whether the effusion develops insidiously, slowly without pain, or acutely and with pain, whether with or without respiratory distress. The physical signs of intrapulmonary disease in these cases may be lacking, but an roentgen-ray plate may show a definite intrapulmonary lesion. A long interval may occur between the attack of pleurisy and pulmonary tuberculosis, which suggests the possibility of a later infection. Dry pleurisy at one apex or double pleurisy is almost certainly tuberculous if no other exciting cause exists.

Hemoptoic.—In some cases the first symptom undoubtedly is hemoptysis, which may occur only once or repeatedly several years before other pulmonary symptoms or signs develop or may be followed by constitutional and local symptoms.

Laryngeal.—Tuberculous laryngitis is rarely a primary lesion, but in an important group of cases the laryngeal symptoms, hoarseness, aphonia, pain, and dysphagia, may entirely mask the pulmonary symptoms.

"Malarial."—Chills, fever, and sweats at the onset occur in a number of cases. The attacks are usually quotidian and may closely resemble those of true malaria. In some instances the chills and fever occur irregularly and rarely every two or three days.

Nervous.—In patients markedly neurotic the nervous system may be early affected by the tuberculous toxin. Neurasthenia is common and may obscure the other symptoms.

The no. of cases of evidence of former glom. dis. that develop marked P.D. is very slight (C. Comrie D m W 1926, 52, 533

Febrile.—Slight but persistent fever is at times the only symptom at onset. In other cases the fever may be pronounced for some days and the patient profoundly prostrated, suggesting typhoid fever.

Anemic or Chlorotic.—Severe anemia or chlorosis may be marked at the onset, especially in women, and lead to a diagnosis of anemia.

Gastric.—Loss of appetite, nausea, some vomiting, great discomfort after eating, distention or an acid dyspepsia with eructations, may be the only symptoms for a longer or shorter period. Emaciation is more rapid than is usual in simple dyspepsia, and the symptoms frequently disappear when the pulmonary tuberculosis is treated.

Diarrhœic.—The onset with diarrhœa, while not common, is often well-marked. It rarely precedes expectoration and slight cough, but predominates all other symptoms. In some cases the swallowed sputum causes an early intestinal tuberculosis which may be the chief symptom but more often a catarrhal enteritis is set up. This form of diarrhœa may continue for months and the patient lose but little weight.

THE COURSE AND DURATION OF PULMONARY TUBERCULOSIS

Course.—Recent pathological studies have led to an attempt to divide pulmonary tuberculosis into two types, *exudative* and *proliferative*, which apparently pursue different courses. The *proliferative* type arises usually along the apical or paravertebral trunks or indeed in the tuberculosis triangular area (above a line running from the root to the middle of the second interspace in the upper axilla). The affected area contains nodules, often well defined which, as the disease progresses, extend downward. They are largest, most numerous and dense at the apex. Ulcerative processes usually occur in the upper half of the upper lobe which is often entirely involved before the apex of the lower lobe on the same side or the opposite apex is involved. The disease in the second lung nearly always spreads in a similar manner from apex to base. Most of the cases in sanatoriums fall in this group which, prognostically, is much more favorable.

The *physical signs* usually follow rather closely this outline of progression. The first changes are often noted just above or below the clavicle, much more rarely above the third vertebral spine. The whole apex next shows abnormal signs which then extend down to the third or fourth interspaces. About this time rales are heard opposite the fourth and fifth vertebral spines, and at the opposite apex. The signs then denote a steady progress toward the bases in advancing cases. In certain cases the physical signs at one apex may clear as they develop at the other. In advancing cases the physical signs may extend along the border of the outward rotated scapula.

In the second *exudative* type, the disease usually arises in the middle of the lung, a deep-seated pneumonic process, which on the roentgen-ray plates appears as a group of overlapping cottony areas. These advance toward the periphery in various directions, and eventually yield signs of bronchopneumonic or pneumonic tuberculosis, and acute often rapidly advancing disease. Such cases are usually seen only in general hospitals.

These two types are frequently mixed and may be difficult to separate clinically or at autopsy. Some hold the exudative rarely arises from but may be found associated with the proliferative type. The second lung may be attacked at the apex in the proliferative type or in the middle third, in which case the process is usually exudative, but rarely are both these sites affected in the same patient.

When the middle third of the opposite side has become involved an area of tubular breathing with whispering bronchophony and resonant rales is frequent in the third and fourth interspaces just outside the nipple line. The physical signs often simulate those of cavity, but later in many cases the only signs remaining are a few fine rales. While frequent on the left side, this condition is rare on the right and may in some cases be the first point affected on the opposite side. In such cases a bronchogenic spread has taken place. When this occurs the apex on the second side is usually spared. The disease more often begins at the right apex but when it advances to the moderately advanced stage, the disease on the right may become stationary and that on the left advance rapidly and become worse than that on the right.

Basal lesions usually mean a secondary infection from an undetected primary focus or an overwhelming primary infection. The disease usually quickly advances in the latter case to excavation, and infection of the opposite side occurs early. The minimal stage of pulmonary tuberculosis may last but a few weeks, but on the average may be said to extend over several months (up to six) and in a few instances may last for years. Some patients who have made perfect recoveries from an advanced stage of the disease may be later found to present signs of minimal disease on relapse.

Duration.—Pulmonary tuberculosis may last but a few days or extend over sixty or more years; the majority of cases run a chronic or subacute course, with more or less frequent acute attacks. The average duration of the acute cases is between three to six months, but many die in less than four weeks. For all cases, acute, subacute, and chronic, the duration may be said to approximate three or four years, while for the chronic it is over twice as long.

Modern treatment greatly prolongs the duration, and this may account in part for the decreased tuberculosis mortality of recent years. Acute tuberculous pneumonia and bronchopneumonia usually last from eight to twelve weeks. From a study of statistics (E. G. Pope), Fig. 14 has been constructed. This shows that about 35 per cent. of all patients die in six months, 50 per cent. in one year, 91 per cent. in four years, and 3 or 4 per cent. live from ten to forty years. Sex seems to exert no influence.

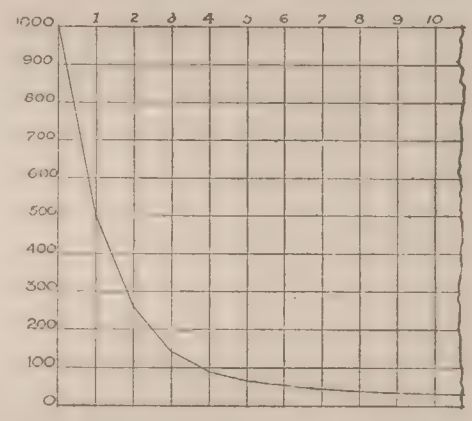
Pulmonary Tuberculosis at the Extremes of Life.—Long recognized as common in children, the frequency of pulmonary tuberculosis has often been overlooked in the aged. The difference in the course of the disease from that in the adult is marked.

In Children.—Pulmonary tuberculosis in children is of frequent occurrence and much more common during the first year of life. Louis' law, that when a caseous focus occurs in the body the lungs are found to be practically always tuberculous, does not hold in children, as Barthez

and Rilliet's figures show that in 28 per cent. of cases of tuberculosis in children the lungs escape. Henoch would substitute "bronchial glands" for "lungs" in this law, which he would then uphold. If the symptoms continue until death the lungs are always affected.

In a large proportion the disease first attacks the bronchial glands whose early involvement and the patency of the lymphatics aid in generalization and prevent localized inflammation and resulting fibrosis. The younger the child the more diffuse is the disease, as a rule, while in older children it is more nearly similar to that in adults. In many cases the same rules hold for children as adults but here intimate exposure, malnutrition, pallor, lassitude and fretfulness, suggest tuberculosis. The physical signs differ from those in adults and "persistent and persistently localized" rales between the fourth and sixth ribs and sternum and anterior axillary line or less often at an apex or over a lobe, on quiet breathing or only after cough, are strongly suggestive of pulmonary tuberculosis which must be excluded by roentgen-rays or tuberculin.

FIG. 14



Proportions of dead and living, of all persons dying from pulmonary tuberculosis: 1, 2, 3, etc., years after onset of the disease, based on State, municipal, and private records of death. The curve follows approximately a straight line after ten years and falls to the base line at forty-one years, the longest duration among the records used being forty years.

Acute processes predominate in early childhood and several distinct forms can be recognized. A latent form in which the only symptoms are emaciation and fever is not rare and pulmonary signs may occur, but only shortly before death. The pneumonic (lobar) form is rather rare, but the bronchopneumonic form is of frequent occurrence. The pneumonic and miliary forms may differ little from similar types in the adult. The bronchopneumonic form may closely simulate simple bronchopneumonia, and if the sputum, obtained from the pharynx by a swab if necessary, the stomach contents, or the feces, contains no tubercle bacilli the diagnosis may present many difficulties. Expectoration is rare under seven and hemoptysis under five. Pleurisy and night-sweats are not frequent. The spleen may be enlarged and intestinal infection is less frequent. Genital tuberculosis is rarer than in the adult, but meningeal complications more frequent. Papulonecrotic tuberculides may occur. Death may occur in one to three weeks in the acute, but the more protracted cases may last from one to three or even six months. In some instances the child may become suddenly ill while teething or during convalescence from fever. There is then a rapid rise of temperature and signs of consolidation; death may follow in a few days (Osler).

Chronic tuberculosis, rare in children under five and not frequent until ten or twelve, in unfavorable cases runs a shorter course than in adults. In many children a remarkable tendency to recovery is often manifested and under sanatorium treatment children as a rule do better than adults. The physical signs are often misleading and cavity formation is rarely recognized under three years, but after the age of eight its signs differ little from those of the adult. Roentgen-ray studies have shown that pulmonary tuberculosis is frequent in "surgical" tuberculosis in childhood but apparently runs a much more benign course than when the lungs are alone infected. A roentgen-ray study should never be neglected. Death takes place usually from the occurrence of one of the acute forms of the disease, from meningitis, or from simple acute bronchopneumonia.

In the Aged.—Senile pulmonary tuberculosis is characterized by a slight tendency to generalization, a marked production of fibrous tissue, and a lessened tendency to degeneration. The disease runs often a very chronic course and may be discovered only by accident in what was thought to be chronic bronchitis, emphysema, or asthma. The examination of the sputum may alone establish the diagnosis. An acute course, however, is not rare. Fever is usually slight or absent in the more chronic forms, cough frequent, and expectoration abundant.

Termination.—This may be in cure, arrest, or death. The use of the word "*cure*" in this connection has met with opposition, and in the sense of a *restitutio ad integrum* is misleading. The test of time proves that many "cures" are only "arrests," and at least two years should elapse before the disease is said to be more than *apparently* arrested.

Patients who recover without any persisting physical signs are chiefly those whose lesion is very slight, or is so deeply seated that it presents at no time physical signs, the diagnosis being made from the sputum and roentgen-ray plates. The majority of patients usually have collapse above or below a clavicle or flattening elsewhere, slight dulness, some change in the vesicular murmur (weakened, rough, or even slight bronchial breathing), possibly increased vocal fremitus or resonance, and in many cases a few fine rales. These signs may persist for ten to fifteen years after the patient has resumed his usual occupation in his home climate. The roentgen-ray changes show that the irregular mottling becomes more linear (stringy) in distribution, with signs of pulmonary contraction. In a few rare cases no abnormal changes remain but calcified areas are common. Cough and expectoration may not entirely cease, and in many cases in which they do the patients are subject to bronchitis. Capacity for work is no criterion of cure, but subjective well-being is important. As long as caseous material is present in the lesion, viable tubercle bacilli may occur and a cure is not accomplished. Cavities of moderate or small size may completely close, but it is not unusual for the signs of excavation to become less marked and finally entirely disappear.

Arrest.—Pulmonary tuberculosis in the vast majority of cases can never be said to be even "*apparently*" cured. Few chronic cases, however, progress so steadily that they cannot be said to be "quiescent" at some

time in their career. These periods, however, are frequently only temporary. Arrest can occur when all hope is seemingly past, and every physician can recall the permanent arrest of the disease in patients whom he has pronounced hopelessly ill. In some instances a self-limitation of the disease is strongly suggested.

Death.—The majority of patients (80 per cent.) with confirmed pulmonary tuberculosis die sooner or later from the disease or from one of its complications. Death by asthenia is the most common form. Death from asphyxia forms 4 per cent. of all deaths; it is more common in acute miliary and pneumonic phthisis than in chronic pulmonary tuberculosis. It may follow an acute exacerbation in a patient doing well. Sudden death occurs in a small percentage of cases, in which at postmortem no gross lesion sufficient to account for it can be found.

Death from *complications* occurs in many cases. Of these hemoptysis is not infrequent (14 per cent.). Death may be almost instantaneous from loss of blood or asphyxia, or follow shortly after repeated hemoptyses from exhaustion. This form of death seldom occurs in the early stages and rarely follows immediately upon sudden exertion. Syncope occurs in about 5 per cent. and frequently after pneumothorax, which is the cause of death in 1 per cent. Empyema is rarely the cause of death, and when present usually follows pneumothorax (natural or artificial). Meningitis (the cause in 3 per cent.) may develop and run its usual course. Other rare causes of death are intestinal perforation and peritonitis, and thrombosis or embolism of the pulmonary arteries.

THE CLINICAL FORMS OF TUBERCULOSIS

It is difficult to separate the acute forms from the chronic processes, and subacute forms are recognized. An acute onset is not infrequent in chronic cases. The classifications are numerous. Some are based upon clinical data alone, others upon pathological findings, but the most satisfactory take both into consideration.

The following classification is used in this article:

I. Acute miliary tuberculosis.
II. Acute pulmonary tuberculosis. (1) Pneumonia. (2) Bronchopneumonia.
III. Subacute pulmonary tuberculosis.
IV. Chronic pulmonary tuberculosis. (1) Chronic ulcerative pulmonary tuberculosis. (2) Fibroid tuberculosis.

I. **Acute Miliary Tuberculosis.**—To many there is an appearance of mystery in miliary tuberculosis; it is set apart as something quite different from the more common chronic forms. If, however, comparative conditions in other infections are kept in mind this difficulty is not so great. If the relation of local infections with a pyogenic organism to pyemia be considered, we have some basis for the explanation of this form of tuberculosis. It may be considered as an acute, general infection, usually showing signs analogous to those of septicemia. The special features in any particular case may be very various and depend both on the acute-

ness of the infection and the distribution of the bacilli. Thus, if the bacilli enter the venous circulation they will reach the lungs especially, if into a pulmonary vein they will be distributed through the general circulation, and if into the portal circulation they may be deposited in the liver. In the great majority of cases the general infection is secondary to a primary focus somewhere in the body. Primary, general miliary tuberculosis may occur, but must be very rare; infection through the tonsil, for example, may be possible.

Given a local focus of tuberculosis there is always the possibility of this infecting the blood stream and so disseminating the tubercle bacilli throughout the body. When we consider how many local lesions there are, the wonder is not that miliary tuberculosis occurs, but that it occurs so rarely. But this general dissemination gives a totally different picture from that of the sum total of a number of local lesions. A patient may have tuberculous disease of many organs, but the results are quite different if these same organs are concerned in miliary tuberculosis. Some consider it as an infectious disease with the bacilli carried throughout the whole body rather than as only a general distribution of tubercle bacilli. The clinical picture may vary greatly, depending on the severity of the infection and the distribution of the bacilli.

Etiology.—In the majority a previous focus must be regarded as essential, although infection through the tonsils or by the cribriform plate of the ethmoid may be possible; these must be regarded as unlikely. The most frequent lesion is in the lungs (50 per cent. by some observers; it is said to occur in 3 per cent. of all cases of pulmonary tuberculosis). Glandular tuberculosis probably comes next in frequency, and then joint, bone, genito-urinary, and pleural lesions. Infection from ulcerative intestinal tuberculosis is not uncommon.

Of exciting causes the acute infections probably take first place, especially measles and whooping cough. Typhoid fever is held by some to have an important influence, but the chances of incorrect diagnosis should be kept in mind. Trauma, operations, especially upon the bones, pregnancy, and debilitating conditions are all at times of importance. Occasionally, it has followed the rapid absorption of a pleural exudate. In patients suffering from chronic maladies, such as arteriosclerosis and nephritis, a terminal acute miliary tuberculosis is not uncommon.

Age and Sex.—Age has an important influence. The largest number of cases occur in early life, especially of the meningeal form. Sex appears to have no influence.

Incidence.—This is difficult to give. Among 1440 cases of tuberculosis of all kinds in the medical service of the Johns Hopkins Hospital in eighteen years there were 60 diagnosed as acute miliary tuberculosis, of which 29 were of the meningeal form. Among the 1440 cases, 980 were of pulmonary tuberculosis. There were 43 cases of generalized miliary tuberculosis among 417 autopsies at the Royal Victoria Hospital, Montreal (J. McCrae), on individuals who had some form of tuberculosis.

It is convenient to consider the disease under two forms: First, that in which the general features predominate, the general or typhoid form; and, secondly, those in which local symptoms dominate. Under the

second the most common are the pulmonary and meningeal forms, although others have been described, depending on the predominance of signs in one system, as the pleura or peritoneum. These divisions do not always hold and some show features of two of them.

General or Typhoid Form.—The picture is that of an acute general infection without any marked local signs. The *onset* is usually gradual, with great malaise, headache, anorexia, and perhaps cough, chills, and digestive disturbances. With this there is fever and often an increase in the bronchitis. The temperature is usually irregular, and there may be intermissions of two or three degrees. The irregularity may be varied, the temperature being elevated fairly constantly for some days, and then showing marked remissions. Persistent high fever is usually seen in very acute cases without much involvement of the nervous system. In some the temperature may fall to normal or even below it at one period of the twenty-four hours. An inverse type of fever is occasionally seen and rarely the course is afebrile. As the disease progresses emaciation becomes marked, there may be delirium, the tongue is dry, the pulse rapid but rarely dicrotic, and the picture is one of severe toxemia. The nervous symptoms are usually marked; restlessness, delirium, subsultus, and hyperesthesia may be present, with more tendency to dulness and coma. Choroidal tubercles may be present. The respirations are usually increased in frequency and the bronchitis becomes more severe. Dyspnœa and slight cyanosis are common and may be present without any marked involvement of the lungs. Cheyne-Stokes breathing may be present late in the course. The pulse-rate is usually high and the heart sounds become feebler, with the first much like the second. Anorexia is usually present and occasionally vomiting. There may be diarrhœa and intestinal hemorrhages. Meteorism is not uncommon and the spleen is usually enlarged. Tubercle bacilli can often be obtained from the blood drawn from the spleen, although this is not to be advised. The urine contains albumin and the diazo reaction is often present. The blood usually shows a leukocytosis and tubercle bacilli may be obtained in cultures. Occasionally there is a hyperemic rash, sometimes in the form of small spots, which may simulate the rose spots of typhoid fever, but it does not come out in crops. Late in the course petechiæ may appear, especially about the wrists.

As the disease progresses the symptoms of pulmonary or meningeal involvement may appear. The course is usually progressive without any period of improvement. The average duration is about four weeks, with usual limits of one to six weeks.

Diagnosis.—This may present difficulty in the distinction from any severe infection, but the diagnosis from typhoid fever is the most important. Miliary tuberculosis is more likely to be regarded as typhoid fever than the reverse. The obtaining of typhoid bacilli from the blood, urine, feces, etc., and the Widal reaction are most important. The temperature curve is usually more constant in typhoid fever; remissions are more marked in miliary tuberculosis. Dyspnœa and cyanosis are usually more evident in miliary tuberculosis. The presence of typical rose spots is important. The spleen may be enlarged in both,

although more frequently in typhoid fever. Leukocytosis is more common in miliary tuberculosis, and the relative increase in the mononuclears in typhoid fever is not found. The result of lumbar puncture may be of help, as typhoid or tubercle bacilli may be found. The finding of choroid tubercles may give the diagnosis.

Treatment.—This can only be symptomatic, and it seems hopeless to endeavor to influence the disease by any therapy.

Pulmonary Form.—In this the pulmonary symptoms predominate and may be severe from the onset. The picture may vary, depending on the relative severity of the general toxemic symptoms and the condition in the lungs. The onset may be sudden, occasionally with chills, and the temperature rises to 102° to 104° F. It is usually irregular and an inverse type may be seen. In patients with previous marked tuberculous lesions the fever may increase gradually. The disease usually begins with the symptoms of acute bronchitis, or in children those of bronchopneumonia. There is shortness of breath and a dyspnœa quite out of proportion to the physical signs. This may be due to irritation of the vagus by tubercles. There are occasionally asthma-like attacks and sometimes Cheyne-Stokes breathing. The cyanosis is usually marked and may be intense. There is considerable cough with expectoration, which is usually seropurulent or mucopurulent, and sometimes even rusty. In a few instances hemoptysis has occurred.

Inspection may show good expansion with full interspaces. Percussion usually gives a full note, which may be quite hyperresonant, especially over the anterior margins of the lungs. In some cases the hyperresonant note is obtained over certain areas, especially in children if there is some bronchopneumonia. The breath sounds are harsh, but may be almost obscured by the adventitious sounds. These are usually heard everywhere, and at first, fine, often very intense, crackling rales predominate. Fine crepitations have been thought to be due to tubercles on the pleura in some cases. There may also be sonorous and sibilant rales, while with the progress of the condition the rales may be coarser and moister. Over areas of bronchopneumonia, tubular breathing may be heard. The sputum may contain tubercle bacilli, possibly from the primary focus, if this be pulmonary. Only in prolonged cases can they come from breaking down of the miliary tubercles.

The pulse is rapid and feeble. The heart sounds are clear, but may be obscured by the rales. Choroid tubercles have been found. The spleen is usually enlarged. The course of this form may be rapid, but in some the progress may become more chronic and last even for months.

The *diagnosis* may offer no difficulty. In some the absence of any definite physical signs, the association of rapid breathing, dyspnœa, and cyanosis, excites suspicion. In some cases of bronchopneumonia, especially in children following an acute infection, it may be difficult. Lobar pneumonia may simulate this disease, but careful examination should prevent error. In bronchitis in elderly people, especially with marked emphysema, there may be difficulty for some days. The intense bronchitis of typhoid fever, especially with early severe toxemia, may cause confusion, but other signs make the diagnosis clear.

Meningeal Form.—Tuberculous Meningitis.—*Etiology.*—In the majority this is secondary to tuberculous disease elsewhere, although in a few it has been suggested that it is primary in the meninges. The acute infections are important factors in determining the onset.

Age.—This form usually occurs below the age of four years, although it may be at any age. Of 52 cases studied by Koplik,[1] 11 were under one year. The average age was a little over four years. The age in 100 cases in children collected by Still showed in the first year 13, from the second to fifth year 70, and from the fifth to the tenth year 17.

Onset.—In the great majority this is gradual. If the disease follows an acute infection the conditions may merge into each other, or previous ill-health may have been due to an existing tuberculous lesion. In 86 per cent. of Koplik's series the onset was gradual. There is usually a history of the child not having been as well as usual, or perhaps there was loss of weight, irritability, anorexia, lassitude and restlessness in children, and in adults a change in disposition, headache, and malaise. The symptoms of a gradual onset may be present for some weeks. Occasionally, older children and adults may show slow cerebration, often with some affection of speech. In some instances the history is of sudden onset, with fever, chills, vomiting, and perhaps convulsions, but this is rather exceptional. An injury may apparently be the determining factor.

The course has been usually described in three stages: (*a*) *The stage of irritation.* In this there is fever, which is often remittent, headache, vomiting, and perhaps convulsions. The child may be restless and much disturbed by twitching of the muscles. The headache may be very severe, and in a child the hand is often put to the head with an unusual cry. This is a curious sound, often characteristic, which has been called the hydrocephalic cry. Some patients scream constantly except when under chloroform. Vomiting may occur but is not often very persistent. The bowels are usually constipated. There may be some rigidity or stiffness of the neck. The pupils are usually contracted. The pulse is generally rapid at first. (*b*) *The stage of cerebral pressure.* The temperature is variable. The irritative symptoms become less marked; the child is dull, difficult to arouse, and may be delirious. Retraction of the head becomes more marked. The pupils are dilated, and there may be ptosis or strabismus. There may be monoplegia or hemiplegia; in others there is rigidity of one side of the body. There may be convulsions. Vomiting may occur, and constipation is common. The abdomen is retracted. The pulse is slow and at times irregular. The respirations are slow and sighing. Cheyne-Stokes breathing may appear. Various skin lesions are common, such as erythema and herpes. (*c*) *The stage of paralysis.* The coma increases and the patient is quite oblivious to the surroundings. Convulsions, either general or local, occur, and there may be paralysis of certain muscles. The pupils are dilated; optic neuritis and paralysis of the ocular muscles may occur. Diarrhœa is common, with incontinence of the urine and feces. The temperature is variable, and may rise to 105° or 106° or fall to subnormal, 94° or 95° F.

[1] *Jour. Am. Med. Assn.*, 1907, **48**, 1149

It is not always possible to recognize these stages. The symptoms show so much variation that they are only more or less general and not necessarily sharply marked. The patient usually lies on one side, with the legs fixed on the body, and resents any attempt to alter this.

Nervous System.—The mental state, except in the early stage of irritation, is usually dull and apathetic. The patients pay little attention to what is going on around them. As the disease progresses the patients may become unconscious, but often it is more a state of stupor. Occasionally a comatose patient arouses for a time and may be quite conscious, only to relapse into coma. Hyperesthesia, so common in the epidemic meningitis, is usually absent. Pain in various parts of the body or limbs may be complained of by older patients. Headache is complained of by adults; in children its presence may be suspected by the crying and the movements of the hand to the head. Convulsions are often present and there may be irregular tetanic contractions of one extremity. Curious associated movements are seen. Some patients suck the lips or have repeated motions of the jaws. If paralysis occurs it is usually hemiplegic or monoplegic. There may be facial paralysis. The third cranial nerve is most frequently involved, in some cases with paralysis of the face, limbs, and hypoglossal nerve of the opposite side.

Kernig's Sign.—This is not constant and was found in only 22 of Koplik's 52 cases. In this series the Babinski reflex in children over two years of age was more useful, being present in 23, and, if found, Koplik considers it an important aid in the recognition of the tuberculous form. The general reflexes are usually present until the later stage, when they disappear. Rigidity is present in the neck in the majority (38 of Koplik's 52 cases). It does not usually appear as early as in the epidemic form, and generally does not cause such marked retraction of the head. It may occur in the extremities. *Paresis* of the muscles usually comes on late and may show variation from day to day.

Lumbar Puncture.—This gives results of the greatest importance. The fluid may be hazy, turbid, and under greatly increased pressure. Rous in thirteen tests found a mean pressure equal to 308 mm. of distilled water (the normal is 120 to 180 mm).. The *protein* content of the fluid is usually increased and may average 1 gm. per liter. In some cases there is reduction of Fehling's solution. The most important point is the presence of tubercle bacilli. The number of cases in which tubercle bacilli are found in the spinal fluid is directly proportional to the care with which they are sought. The fluid should be free from blood, centrifugalized for a considerable time, the sediment stained and long search made in the slides. Tubercle bacilli were found in 135 of 137 cases observed by Hemenway. The fluid may be injected into guinea-pigs, which is certain, but slow.

Cytology.—As a rule, the total number of cells is much increased. The most striking finding is the large percentage of mononuclear cells (usually over 90 per cent.). In rare cases the polymorphonuclear leukocytes may predominate, but no rule can be laid down as to any special significance of this. Aside from the presence of tubercle bacilli and a large percentage of mononuclear cells, the other information obtained by lumbar puncture

is rather more valuable in excluding tuberculous meningitis. When the pressure, amount of protein, and the cellular elements are normal, these must be regarded as being strongly against tuberculous meningitis.

Percussion of the Skull.—Koplik called attention to the importance of Macewen's sign in the recognition of internal hydrocephalus in young children. He found it in 34 of 52 cases. The patient should be upright, with the head slightly inclined to one side, the skull being percussed over the pterion. A tympanitic note speaks for internal hydrocephalus. This sign may be present comparatively early in the course.

Eyes.—Ptosis and strabismus may occur. The pupils are usually contracted in the early stages, but as the disease progresses become dilated, and toward the end may give no reaction to light. In some cases an oscillation of the pupils between contraction and dilatation is seen. Inequality of the pupils is common in adults. The changes in the *fundus* are important. The disk may be swollen, with indistinct margins and the veins distended; or there may be optic neuritis, usually present in the latter part of the course. In two-thirds of Koplik's cases there was some change in the disk. The presence of choroid tubercles is the most important finding. The reports as to the frequency vary greatly, some having failed to find them in a number of cases. In 9 among 46 of Koplik's series they were found in the second day of active symptoms.

Duration.—This varies greatly. There are cases, usually in adults, with a very rapid course, the acute features lasting only a few days. On the contrary, the duration may be prolonged, the condition becoming one which might almost be termed chronic meningitis. This is especially likely if the meningitis be limited, when psychial symptoms or those suggestive of brain tumor may predominate. The average duration is between three and four weeks. In some instances there are periods of improvement followed by relapse and the improved condition may be so marked that doubt is cast on the diagnosis. In some the course is almost latent and the duration is impossible to state.

Diagnosis.—This must first be made in regard to the presence of meningitis and secondly as to the variety. In the early recognition of tuberculous meningitis, the former of these is likely to give the greater difficulty. In children the symptoms at onset may be much like those of any febrile attack or gastro-intestinal disease. Headache, convulsions, vomiting without cause, respiratory signs, especially sighing respiration, a retracted abdomen, rigidity of the neck, Kernig's sign, and Brudzinski's sign, are all suggestive.

In children the *exanthemata* may give difficulty for a few days. The appearance of the rash of each disease gives the diagnosis. From typhoid fever, the more irregular fever, the absence of the rose spots, the Widal reaction, the decubitus—dorsal in typhoid fever, lateral in meningitis; the headache, complaint of which ceases in typhoid fever with the onset of delirium but persists in meningitis, and the results of lumbar puncture, all aid. Some cases of indefinite, continued fever in children, sometimes with glandular tuberculosis, may give difficulty. The course and the results of lumbar puncture are the greatest aids. There may be great difficulty in making a diagnosis from hysteria, beginning mental disease,

or delirium tremens. Some intracranial conditions cause confusion, such as otitis media, thrombosis of the cerebral sinuses, cerebral syphilis, cerebral abscess, and cerebral tumor, especially if tuberculous.

The diagnosis of meningitis being made, the recognition of its character as a rule offers less difficulty. By far the greatest aid is lumbar puncture. With care and perseverance, tubercle bacilli may be found in a large percentage of cases. In their absence the finding of a large proportion of mononuclear cells in the fluid is suggestive of the tuberculous form. The presence of a tuberculous focus elsewhere is of importance. The presence of tubercles in the choroid is positive. The examination for them should be made every day.

Prognosis.—The few recoveries reported, even after finding tubercle bacilli in the spinal fluid or choroid tubercles, stand out as such exceptions, that the outlook must be regarded as practically hopeless.

Treatment.—When the disease is established, the patient should be kept as quiet as possible, and in a darkened room if there be photophobia. If there is difficulty in swallowing, the stomach tube may be necessary. In case of vomiting, various sedatives may be given and rectal feeding employed. The ice-bag to the head may give relief to headache, but if this be severe, with great restlessness, or convulsions occur, bromide, chloral, or morphine, hypodermically should be given. A hot bath, at 105° to 115° F., may be given every four to six hours. Blisters and other methods of counter-irritation are to be condemned. Lumbar puncture should be repeated at intervals, depending on the amount of fluid obtained, the degree of pressure, and the influence on the symptoms. Surgical methods, such as trephining or opening the spinal canal, have not had sufficient success to justify their use.

II. **Acute Pulmonary Tuberculosis.**—The pulmonary form of acute tuberculosis can occur in two types, the pneumonic and the bronchopneumonic. Both constitute not more than 10 per cent. of all cases of pulmonary tuberculosis.

1. **Acute Tuberculous Pneumonia.**—This form, known also as acute phthisis, acute pneumonic phthisis, caseous pneumonia, and epithelial pneumonia, is more frequent in adults than in children, but is the rarest of acute forms. Many cases are no doubt instances of confluent multiple foci, but in a few the disease invades a whole lobe at once. Males are more frequently attacked and are often robust and between twenty and forty years of age. The infection is usually bronchogenous, but may be hematogenous (Tendeloo). The *onset*, usually acute, and the course for some days closely resemble those of lobar pneumonia. A chill may usher in the attack and physical signs of consolidation of an entire lobe usually the upper, appear in a few days. Herpes labialis is not uncommon (Kidd). The bronchial breathing has been described as distant and suppressed, but in many cases this is not so. The sputum is frequently tenacious, rusty, and for some days closely resembles that of lobar pneumonia. Pneumococci, but no tubercle bacilli, may be present, and unless a previous history of pulmonary disease is obtained a diagnosis of frank pneumonia is made. The crisis does not occur, resolution is delayed, the fever assumes a more hectic character, the patient emaciates, and the

sputum takes on a greenish tint. Tubercle bacilli have been found as early as the fourth day (Osler), but more frequently not until the crisis fails to appear. Elastic tissue is less frequently found than in caseous bronchopneumonia.

When the lower lobe is involved, signs of infiltration may be found at the apex; or if, as is more common, the upper lobe, an infiltration at the opposite apex. The physical signs may not agree with the date of appearance of the disease. Dry tuberculous pleurisy is almost always present. The temperature is usually high, but remittent throughout, and from the first shows a wider range than is usual in lobar pneumonia, which runs the same course in the tuberculous as in the healthy subject (Fox). The pulse ranges from 100 to 130, while the respirations vary between 30 and 40. Cyanosis is not usual, but in cases of some duration, anemia of the lips and mucous membranes is common. The dyspnœa is much less marked than in the acute miliary type. Emaciation is often a prominent feature, and may be accompanied by great prostration. Hemoptysis sometimes occurs at the onset and may cause death. Albuminuria is infrequent, the diazo reaction rarely absent.

The *duration* may be but three or four weeks (Tendeloo had a patient die on the sixth day), but more usually it extends over three or four months. A few patients pass into the chronic stage and live for two to five years, but rarely if ever fully recover. The usual course is progressive. Death occurs chiefly from asthenia, frequently aggravated by tuberculous enteritis, laryngitis, and in a few cases from meningitis.

2. **Acute Tuberculous Bronchopneumonia.**—This form, described under the names of phthisis florida, galloping consumption, or caseous bronchopneumonia, is the more common acute type. In children and the aged it closely simulates simple bronchopneumonia, and the diagnosis may not be made for weeks.

The *onset* is occasionally acute, but more often insidious, with cough. When this acute form supervenes upon a more chronic type, as is common, it frequently follows hemoptysis and is due to aspiration. It not infrequently follows influenza, or, in children, measles or pertussis. The symptoms are usually pronounced. The cough in some cases, dry at first, soon becomes loose. The sputum, variable in amount, early contains tubercle bacilli and elastic fibers. The patient at first presents a rapid pulse, high, often fluctuating temperature, and quickened respiration. The physical signs, at first indefinite at an apex, soon become more pronounced, and when softening and excavation occur, which are rapid in many cases, chills and night-sweats are common. The patient rapidly emaciates and loses strength. Hemoptysis is infrequent, but diarrhœa is often present. Death may occur in three or four weeks, but the disease may last three or four months, or the acute symptoms subside and the disease become chronic.

Three types of caseous bronchopneumonia can be recognized. The first occurs in patients already tuberculous, and is due to the aspiration of blood and secretions, often from an old, apical cavity. The resulting symptoms are those of a secondary infection. The second type (due also to aspiration and rarely to hematogenous infection) is the peri-

bronchial or nodular. Small, solid, caseous foci, the size of a pea or walnut are found surrounding a bronchus. Diffusely scattered, fine rales, with little or no dulness, and sputum free from tubercle bacilli, are characteristic phenomena. The third form, the disseminated ulcerative type, frequently following diabetes, pregnancy, alcoholism, influenza, measles or pertussis, usually terminates fatally in two to four months. It is frequent in children between two and six years of age. Death from hemoptysis, meningitis, or miliary tuberculosis is usual.

III. **Subacute Pulmonary Tuberculosis.**—Comparatively few cases run an acute course from start to finish, but in a very large number the disease is never completely quiescent but smoulders along with an occasional acute outbreak. The symptoms lessen, the weight and strength increase, the morning temperature falls to normal or below, but each day at some time a temperature of 99.5° to 100° F. occurs. This may persist for weeks, but sooner or later it gives way to a return of the night-sweats, increased cough and expectoration, with possibly pleuritic pain or dyspnœa; the morning temperature no longer falls as low as normal, and the disease makes rapid headway for a few weeks. This may be repeated for one or two years, but with each successive attack the patient regains his lost strength and weight less readily, the dyspnœa is more continuous, and finally the whole of both lungs becomes involved. Finally and usually during one of the periods of acute exacerbation, the patient dies from asthenia or possibly some slight complication occurs which he is not able to resist. This type is frequent in developing females, follows the puerperium, or occurs when the constitution has been undermined by chronic disease, such as alcoholism, syphilis, or diabetes.

IV. **Chronic Pulmonary Tuberculosis.**—Chronic pulmonary tuberculosis, phthisis, consumption, includes the large majority of all cases of pulmonary tuberculosis. The course, extending usually over about ten years, is marked with many remissions and temporary arrests. Many chronic cases begin acutely and continue so for some little while. Every acute form may become chronic, even miliary tuberculosis of the lungs. The distinction between acute and chronic forms depends largely upon the fever. In the first it is constant, remittent, intermittent, or even absent for a short but fleeting period. In the second it is absent for long periods and its recurrence is usually marked by an increase of symptoms. The disease may remain stationary at one place, or even improve, while advancing in another. Two well-defined subdivisions may be made: the ulcerative and the fibroid form.

1. **Chronic Ulcerative Pulmonary Tuberculosis.**—This form, the usual type, is characterized in well-marked cases by cavity formation and induration. The disease has usually long periods of quiescence, or arrest may go on to cure. In other cases at infrequent intervals acute attacks occur, and in each a slight extension of the disease takes place.

2. **Fibroid Tuberculosis.**—Some cases of chronic pulmonary tuberculosis, lasting from ten to twenty years, or even longer, are characterized by the extensive formation of fibrous tissue which overshadows caseation or ulceration, if present, or entirely replaces the tuberculous changes. The most marked alterations in the shape of the chest occur in these

cases; one apex or base may be greatly retracted, move little or not at all, and present marked dulness. The heart is often displaced, murmurs are common, and hypertrophy of the right side may occur, with possibly signs of deficient aëration, first noticed in the nails and lips.

Dyspnœa on exertion may be pronounced and dilatation of the bronchi is common. The cough is often paroxysmal and, while effective, of little force. Fever may be absent for long periods or very slight when present. Hemoptysis is not infrequent. The onset is rarely acute.

Fibroid disease of the lungs was long looked upon as a pathological entity, but the fibroid changes are usually limited to one lung or a portion of one lung, rarely involve the whole or both, as is common in sclerosis of the liver or kidneys. Clarke distinguished three forms of fibroid phthisis: (1) Tuberculo-fibroid, the generally accepted fibroid phthisis; (2) fibro-tuberculous, the fibroid disease supposed to be primary, the tuberculosis secondary; and (3) pure fibroid, without apparent cause of the fibrosis, a point criticized by West. Patients with fibroid pulmonary tuberculosis are threatened with three dangers: (1) Hemoptysis usually profuse; (2) extension or generalization of the tuberculosis; and (3) failure of the hypertrophied heart.

An attempt has been made to separate the ordinary ulcerative pulmonary tuberculosis into exudative and proliferative groups, but as both changes can occur in the same case, and as an acute exudative process can supervene upon an old proliferative change, the division is often difficult. Cases in which the proliferative changes occur are less likely to become acute, run a slower course with fewer symptoms, and in the opposite lung the changes occur chiefly at the apex. In the exudative cases a more rapid advance occurs, and the second lung is usually involved by a bronchogenic spread, manifesting itself in the outer third and fourth interspaces.

Latent Pulmonary Tuberculosis.—This term is used to include forms in which the symptoms or the physical signs may be latent. In the one the symptoms may be suggestive or even pronounced, but physical signs are often lacking. On the other hand, a routine examination of the chest, often made on an applicant for life insurance, reveals well-marked signs, when little or no history of symptoms can be obtained (masked pulmonary tuberculosis). In either case, more often in the former, the sputum may remain free from tubercle bacilli (closed pulmonary tuberculosis). In this group belong the cases of phthisis ab hemoptoë or sudden pneumothorax in apparently healthy patients. When the disease begins about the root (hilus tuberculosis) it is often for a long time only a disease of symptoms as physical signs may give no aid in diagnosis. Here roentgen-ray study is invaluable.

A small number of patients present very indefinite pulmonary signs throughout the course. Tubercle bacilli occur in their sputum, and many show rather extensive changes on radiographic examination.

Chronic excavation may exist with every appearance of health. Cure rarely occurs after the formation of a cavity, but arrest is frequent, and many patients with a limited cavity at one apex enjoy years of comparative health. The physical signs gradually disappear from the front,

to persist at the apex posteriorly for a long time. In other patients the cavity walls secrete profusely. Excavation of an entire lobe, unusual and more frequent in men, occurs equally on the two sides, but affects the upper more than the lower lobe. Complete excavation of an entire lung is very rare.

COMPLICATIONS OF TUBERCULOSIS

The complications of so chronic and debilitating a disease are numerous. They can be divided into those due to the action of the tubercle bacilli or its poisons and those due to other factors. The complications caused by the tubercle bacillus are always serious, indicating a weakened resistance. Secondary tubercle in primary lung disease may arise in one of three ways: due to direct infection from contact with the sputum, *e. g.*, in the larynx, tonsils, nose, intestines; from direct extension of the disease, *e. g.*, into the pericardium, pleura, chest wall; or the bacillus may be carried, possibly in leukocytes, through the lymphatics or bloodvessels to distant organs. The infection transmitted by this last method may be localized in the brain, meninges, bones, ear, peritoneum, or lungs, or be generalized in the peritoneum, serous membranes, lungs, or throughout the body. The irritants in the sputum may produce bronchitis, tracheitis, laryngitis, pharyngitis, and if swallowed, gastritis and diarrhœa. When absorbed into the circulation they may cause anemia, neuritis, atrophy, and fatty degeneration of the muscles and even of the heart. In late stages, thrombosis, dropsy, amyloid and other diseases, not peculiar to pulmonary tuberculosis, may occur.

Respiratory.—Secondary Infection.—The chronicity of the disease, the frequency of abnormalities in the upper respiratory tract, especially in the nose, the intercurrent bronchitis, the partial destruction of the ciliated epithelium of the lower air passages, as well as the frequency of micro-organisms in the dust of buildings and cities, lead us to believe that, the usual defences being broken down, secondary infection is of frequent if not of constant occurrence. But not all cases of pulmonary tuberculosis even at necropsy show secondary organisms in the pulmonary lesion. Ravenel and Irwin reported 3 cases of cavity formation which were sterile. Ophüls reported 7 out of 13. Many tuberculous lungs harbor harmless bacteria, which in no way influence the course of the primary disease. These should not be spoken of as instances of mixed infection, but the term should be reserved for those cases in which one or more secondary organisms exert some discoverable influence. Hayes found a hemolytic streptococcus in a large percentage of throat cultures, from washed sputum, and at autopsies in caseous material and in cavities of tuberculous patients.

While secondary infections are usually looked upon as harmful, some hold that they may exert a favorable influence upon the pulmonary tuberculosis (Sata). It is probable that the prevailing secondary organism is not always the same. Many and in fact the majority of the organisms almost constantly present in advanced stages possess little or no

The use of the bronchoscope may aid in diag.

pathogenicity for animals. The organisms recovered from the lungs are nearly always of low virulence, and in one instance a streptococcus obtained at autopsy, very virulent for animals, was found on subcutaneous injection into man to produce only local changes, suggesting those of an insect sting. Their effect upon the patient is not yet definitely determined, notwithstanding the claims of many authorities, who would attribute to the secondary infection the disintegration of the pulmonary tissue (Prudden), and the fever, as well as an abundant expectoration and spreading pneumonia. It is impossible to exclude preagonal and postmortem invasion by secondary organisms in pathological specimens. A number of observers have obtained positive blood cultures but no causative relation to the fever or symptoms of the pulmonary tuberculosis has been definitely established. Whatever results may be forthcoming, the injection of tuberculin or of tubercle bacilli in pure culture may cause fever under such conditions that the influence of secondary organisms may be almost positively excluded.

Careful work has been done to determine the bacterial variation in sputum coincident with increase of symptoms but with negative results. Still the grave importance of some mixed infections cannot be questioned. On the whole it seems as if mixed infection was not as important as some would have, but that it is not to be neglected is borne out by the fact that the majority of patients with pulmonary tuberculosis do far better in the country, removed from constant reinfection with secondary organisms in the cities. Little light has been thrown upon this subject by the patient's opsonic index to the secondary organisms recovered from the sputum. The favorable results following the use of vaccines in a few patients do not prove that the infection was mixed.

Upper Air Passages.—The tendency to contract colds and other affections of the upper respiratory tract is very marked. Moeller and Rappoport have shown that in 120 patients with pulmonary tuberculosis the nose showed some pathological change in 84 per cent., the pharynx in 76 per cent., and the larynx in 42 per cent.

Tuberculosis of the Nasopharynx.—This usually attacks the cartilaginous septum, but may occur at the juncture of the skin and mucous membrane. *Pharyngeal tuberculosis* occurs as a complication usually late in pulmonary tuberculosis. The *tonsils* are frequently found tuberculous at postmortem but as there are no definite symptoms or characteristic appearance it is rarely recognized clinically.

Larynx.—This is discussed elsewhere.

Aphonia.—This may occur from hysteria, a functional paresis of the adductor muscles of the vocal cords (especially common in women), from pressure of enlarged glands, bronchial or cervical, apical infiltration and shrinking, or pleurisy, upon the recurrent laryngeal and resulting paralysis (rare), and from mucus or secretion on the vocal cords (transitory), as well as from tuberculous involvement of the larynx.

Bronchi.—Bronchitis is a constant accompaniment of pulmonary tuberculosis, and while in most instances due to irritation from the poisons of the sputum and secondary organisms it may be a true tuberculous bronchitis.

Pneumonia.—Simple *bronchopneumonia* occurs in many cases as a complication. *Acute lobar pneumonia* is, in health resorts, rarely diagnosed as a complication of pulmonary tuberculosis and appears to be more frequent in large cities. In a tuberculous patient it may run its ordinary course and terminate by lysis or more rarely by crisis.

Epidemic influenza ran a more or less benign course in many patients with open tuberculosis but apparently awoke the disease in many closed and latent lesions.

Gangrene and Abscess.—These rarely occur in pulmonary tuberculosis (in less than 1 per cent., West). In a few instances the walls of a cavity become gangrenous, but this is much more unusual than the fetid decomposition of the secretions in cavities. Abscess also seldom occurs.

Bronchiectasis.—This, while rare in the more acute forms, is far from unusual in fibroid pulmonary tuberculosis.

Emphysema.—This is frequent in pulmonary tuberculosis and in some instances may mask it. Compensatory emphysema is frequent in chronic cases on the less affected side, and may be so marked that the lung extends well across the middle line. Interlobar emphysema may occur. In rare instances caseation of a bronchial gland may lead to ulceration of a bronchus, or the rupture of an adherent cavity into the tissues of the chest wall may occur, which produces general subcutaneous emphysema. It is not uncommon during collapse therapy and usually apart from temporary discomfort is of no moment.

Atelectasis.—Areas of atelectasis are frequent in patients usually middle aged, in advanced stages, with shrunken chests.

Asthma.—Pulmonary tuberculosis may occur in an asthmatic, ~~but~~ and asthmatic attacks are not infrequent when the tuberculous disease becomes chronic and the fibrosis pronounced.

Pleura.—Pleurisy occurring in tuberculosis has been grouped by Osler under three heads: (1) Acute tuberculous pleurisy, (2) subacute and chronic pleurisy, and (3) general serous membrane tuberculosis.

Dry pleurisy may be said to occur almost constantly from extension of the process to the pleura. It may be primary (miliary tubercle). There is little doubt that the majority of obliterative pleurisies are tuberculous. Marked thickening of the pleura may occur, but this usually follows an effusion. Diaphragmatic and apical dry pleurisies are not uncommon. In the former the pain may be referred to the shoulder or to the abdomen. Apical pleurisies, van Zwalumenburg held, were caused by infection from the cervical lymphatics and in turn caused pulmonary involvement.

Pleurisy with effusion is far from infrequent in pulmonary tuberculosis, although it occurs much more frequently at its onset than during its course. The effusion is usually (80 per cent.) serofibrinous, but may be serous or in rare instances hemorrhagic. Chyliform or milky exudates may occur. The effusion may be interlobar. Tuberculous abscesses of the chest wall are not uncommon and may arise from pleura or bone.

Pneumothorax.—Pulmonary tuberculosis is said to be the cause of 80 to 90 per cent. of all cases of pneumothorax. It is, however, a rare accident in the minimal stage, and postmortem figures, including a

Pneumonia
Pulmonary Resection Am Jr 1925 T 888 — Simson

Simson + Freiheit (Ill. Med Jr 1927, , 73) P.T. & Ch. more common than generally recognized. Is imp. factor as source of infection than sputum.

Case of injury arising behind the heart — may produce an x-ray picture suggesting a perforated ulcer. But the pain, &c. and the fact that it is on one side more, of the heart-producing blowing is seen while is absent on the other should put one on his guard.

Morrow & Miller (JAMA 1924, 83; 1483) Portal 1804 described 1st case
Lue. tongue. Rare - 282 in literature, Seldom primary, more common
than thought (14 in 1444 cases). Remove all or none. Says best tr.
surgical!

Duodenal ulcer in 9 of 25 autop. of U.S., usually chronic
Lisa (JAMA de 1905, 86; 1918)

number of undiagnosed cases, show it to occur in about 5 per cent. of all autopsies in pulmonary tuberculosis. The lung must be at least partly free from adhesions, and usually a rapidly advancing caseous process with cavity formation is found just under the pleura, at the point of rupture, usually on the left side. Pneumothorax occurs in the acute pneumonic or caseous type of pulmonary tuberculosis, never in the fibroid form, and no cases have been reported in acute miliary tuberculosis of the lungs. The subphrenic abscess described by Leuden may closely simulate pneumothorax.

The results of pneumothorax may be divided into immediate and remote. They depend, especially at first, upon the general condition and more particularly upon the state of the opposite lung. When the result is not immediately fatal, effusion almost always takes place. The effect on the compressed lung has been held to be favorable but the opposite lung is often observed to become more involved. On the whole, it may be said that pneumothorax is always a serious complication, may in rare instances be recurrent, and often results in death.

Empyema.—This is rare in pulmonary tuberculosis, and usually in advanced stages and following pneumothorax; it is always serious.

Ear.—Tuberculosis of the middle ear, more common in males, is rather frequent, and may be caused by infection through the Eustachian tube.

Gastro-intestinal.—Complications occur more frequently in the gastro-intestinal than in any other system. Thrush may penetrate into the glands and form thrombi and metastatic brain abscess. Stomatitis is infrequent in patients with good surroundings. Aphthous ulcers are common. Pyorrhœa alveolaris is frequent and slight gingivitis is not uncommon. Dental caries is frequent, and of great importance on account of imperfect mastication, and of infection with tubercle bacilli or secondary organisms. Alveolar abscess is rather frequent.

Tuberculosis of the *buccal cavity* is of very rare occurrence; the tongue and the tonsils are most often attacked. The tongue, from frequent slight injuries, is more liable to infection, which usually occurs upon its tip or edges. The gums and hard palate are attacked more rarely than the soft palate, uvula, and pillars of the fauces. The posterior pharyngeal wall and the lips are rarely affected. Tuberculosis of the salivary or parotid glands is uncommon.

Gastric Tuberculosis.—Tuberculosis of the stomach, while never primary, is very rare. Various explanations for this have been offered and Broders concludes that the acidity of the gastric juice in healthy conditions is probably sufficient to prevent the development of tuberculosis, but insufficient if a local point of lessened resistance occurs. Males are more often affected. The most frequent site is the pylorus, and the ulcers were multiple in half of the cases collected by Blumer. Arloing believes the infection is hematogenous. The ulceration may produce remarkably few symptoms, and be entirely overlooked.

Gastric Ulcer.—Simple ulcer is rare in pulmonary tuberculosis (2 instances in 1000 cases at the Trudeau Sanatorium).

Intestinal Tuberculosis.—This is the most frequent of all tuberculous complications in chronic pulmonary tuberculosis, but is rare in the

acute forms. The great discrepancy between the symptoms in life and the postmortem findings can be explained only by its latency. The *symptoms* are notoriously uncertain. Diarrhœa may be absent throughout or alternate with constipation. This depends less upon the extent of the ulceration than upon its site (more pronounced if in the lower colon) and upon the accompanying catarrhal inflammation.

The *stools* vary greatly in frequency and character. Blood in any quantity is rare, but several instances of death from intestinal hemorrhage have been reported. The discovery of tubercle bacilli in the stools is of little value, for in nearly all patients with pulmonary tuberculosis they are present if the sputum contains tubercle bacilli. Nausea may be present and thirst is often marked. Pain, more often low in the abdomen, is usually colicky and occurs with greatest intensity after food or before defecation. It may be slight or severe and continuous. Chronic diarrhœa in pulmonary tuberculosis is most often associated with intestinal tuberculosis. A method of diagnosis has been worked out by Brown and Sampson from a study of the barium meal. It is found occasionally in the minimal, often in the moderately advanced, and frequently in the far advanced cases. The most important complications are perforation and stenosis. Tuberculous stenosis may occur from concentric hypertrophy in the hypertrophic form or from contraction of scar tissue, formed in a cicatrizing ulcer. Many cases recover under natural and artificial heliotherapy. The *hypertrophic form* of intestinal tuberculosis occurs chiefly about the ileocecum. The connective-tissue hypertrophy causes a concentric narrowing, although tumors are found at times closely resembling malignant growths. Middle-aged males with slight or slowly advancing pulmonary disease are usually attacked.

Appendicitis.—Simple appendicitis may possibly occur more frequently in patients with pulmonary tuberculosis than in the healthy. It runs its usual course and the same indications for operation exist. Nitrous oxide and oxygen should be used as an anesthetic. The symptoms are often slight and obscured by the preëxisting pulmonary and intestinal tuberculosis, which can now be excluded, but the appendicular disease should not be first discovered at necropsy.

Rectal Ulceration.—This is fortunately not common, as it can cause severe pain, both continuous and increased on defecation. If attempts at healing occur, stenosis may result, which is rare, as the condition is usually found only in advanced stages.

Fistula-in-ano.—*Ischiorectal Abscess.*—Fistula is a rather frequent complication, occurring in about 3 per cent. of all cases. About 10 to 20 per cent. are tuberculous (Stone). It rarely occurs in early life, is uncommon before twenty, most frequent from twenty to forty, and is not rare in senile tuberculosis. It may first call attention to the pulmonary disease, or, as is more usual, occur in advanced stages associated with ulceration of the rectum. The onset is usually with a perineal or ischiorectal abscess, which (when incised) fails to heal. The chief symptoms are: Severe pain, especially on coughing and defecation, but after free drainage the symptoms may be so slight as to escape the patient's notice. Many fistulæ have no discoverable opening into the rectum. In early cases a fistula

may exist and cause little or no trouble, and precede the pulmonary symptoms by years. Caries of the coccyx may occur.

Peritonitis.—Acute peritonitis follows most often acute appendicitis or perforation of a tuberculous ulcer. Peritoneal tuberculosis is infrequent in pulmonary tuberculosis, and most often consecutive to some abdominal complication, *e. g.*, tuberculosis of the mesenteric glands, of the intestine or of the Fallopian tubes.

Circulatory System.—Heart.—The coincidence of pulmonary tuberculosis and heart disease occurs in about 1 per cent. of all cases of pulmonary tuberculosis. Acute endocarditis occurs in 5 per cent. of the cases of pulmonary tuberculosis. Tuberculous endocarditis is exceedingly rare.

Mitral insufficiency is the most frequent form in pulmonary tuberculosis, as the age incidence is more nearly similar. It is said not to predispose to pulmonary tuberculosis, and, if the compensation be good, may exert no unfavorable influence upon the pulmonary disease, and may even retard it. Mitral stenosis was held to be distinctly inhibitory to pulmonary tuberculosis, which is usually of an abortive form. The prognosis is good. Aortic insufficiency is much less likely to be found with active than with healed pulmonary tuberculosis. Pulmonary stenosis, always congenital, commonly predisposes to pulmonary tuberculosis, which, however, may develop slowly, although it is frequently miliary (Fox). Tricuspid insufficiency is rare, but may be a great source of danger in benign chronic cases with sclerosis.

In an electrocardiographic study of 97 cases, Boas and Mann found 29 per cent. with right, 30 per cent. with left, and 41 per cent. without any ventricular predominance. It occurred on the right more often in the younger and in men but was not associated with the fibroid type nor with pulmonary adhesions. Right predominance occurred more in the older patients and in women. Non-tuberculous *myocardial* degeneration is not rare. Myocardial tuberculosis is very infrequent and often secondary to tuberculous pericarditis.

Pericarditis.—Tuberculous pericarditis usually secondary, and often overlooked, is not common. It may arise from direct extension from the pleura or from perforation from a tuberculous cavity. It occurs in children more frequently than in adults and in men more than in women. The course tends to be chronic.

Arteries and Veins.—Embolism rarely occurs and is recognized in the lungs only when a hemorrhagic infarct forms. Thrombosis is not uncommon, occurs more frequently in the veins, and usually when cachexia is marked. Phlebitis is not infrequent.

Anemia.—Pernicious anemia and leukemia rarely coëxist with pulmonary tuberculosis. In the former the blood picture may improve as the tuberculosis grows worse (Ehrlich), and pulmonary tuberculosis as a complication of leukemia may modify the blood findings.

Nervous System.—Meningitis.—Tuberculous meningitis, practically always a terminal complication (40 cases of recovery have been reported), occurs in about 8 per cent. of all cases. All the symptoms of meningitis can occur and at postmortem no gross lesions be observed. Spinal menin-

gitis can occur alone as well as cerebral (basilar), but is rare and almost always exists in the cerebrospinal form as meningomyelitis.

Genitals.—Tuberculosis of the epididymis, often involving both sides, is not uncommon. It begins usually in the globus major.

Urinary Organs.—Secondary tuberculosis in the genito-urinary system, apart from the kidneys, rarely occurs in pulmonary tuberculosis (Krzywicky places it at 5 per cent.).

Nephritis.—The frequency of nephritis varies much with different observers, but careful observation reveals more frequent changes than were formerly suspected. The nephritis may affect the symptoms of the primary disease to a certain extent. The temperature may become lower, the pulse faster, and the blood-pressure higher. The specific gravity of the urine is high and a few hyaline and granular casts are nearly always present. The symptoms may disappear for several months. Albuminuria is not always present even when extensive lesions exist in the kidneys. Renal complications are usually insidious in their onset and slow in their course. Cardiac hypertrophy is unusual.

Albuminuria.—This is rare in minimal pulmonary tuberculosis. It was present at some time after repeated examinations in 62 (5 per cent.) of 1214 patients in all stages at the Trudeau Sanatorium and is not always present in tuberculous nephritis. Always of unfavorable prognostic significance, it demands cessation of treatment of the pulmonary tuberculosis only when pronounced. Albumoses are said to have been found in the urine of patients who after vigorous exercise suffer from fever (Ott). Their presence has been suggested as a contraindication for exercise, but is of little value.

Pulmonary Tuberculosis in Nephritis.—Pulmonary tuberculosis is found in nephritis as frequently as nephritis in pulmonary tuberculosis. Secondary tuberculosis may run a slow course in chronic nephritis and the fibroid type is common. In amyloid disease of the kidney 37 per cent. are said to have had pulmonary tuberculosis. Senator finds that in Berlin chronic parenchymatous nephritis is due more frequently to tuberculosis than to any other chronic disease.

Cutaneous System.—The skin frequently presents changes, which are rarely tuberculous. Chilblains are frequent and the tendency to vascular paresis favors the development of erythema pernio. *Purpura hemorrhagica* rarely occurs, but a fatal case has been reported. But 3 well-marked cases of purpura occurred in 1000 cases at the Trudeau Sanatorium. One was a typical case of Henoch's purpura in a man aged thirty-one years; another was associated with joint symptoms. Herpes zoster is not uncommon. Tinea or pityriasis versicolor occurs in about 5 per cent. of favorable cases. Various forms of erythema are described. A macular form is more common in acute tuberculosis and the other forms are rare. Lupus and erythema nodosum occur very rarely as a complication of pulmonary tuberculosis; tuberculous warts (verruca necrogenica) are of extreme rarity.

Lymphatic Glands.—Enlargement of the cervical and axillary glands may take place, and in some the glands break down and suppurate, although usually they are just palpable and remain unchanged. In

There seems to be no increased susceptibility to insulin
[illegible] Ahlenstiel D.m.W. 1926, 54, 1103.

some instances the pus may be loaded with tubercle bacilli. Enlarged tracheal or bronchial glands may cause symptoms referable to compression. The physical signs of enlarged bronchial glands, usually more evident in children, are rarely well-marked in adults. The symptoms may subside, or suppuration or resolution occur.

Thyroid Gland.—This is frequently slightly enlarged and symptoms suggestive of hyperthyroidism are not infrequent, especially in women. Tachycardia may be pronounced.

Mammary Glands.—Hypertrophy may occur, but is unusual, and is more frequent in men.

Superficial Thoracic Abscess.—Superficial cold (tuberculous) abscess of the thorax is not common in pulmonary tuberculosis. It is usually connected with tuberculous osteitis of the ribs or sternum, or arises from the pleura or lung, but in some instances lies deep under the pectorals and seems to be primary in the muscle. At times these abscesses closely simulate a pointing empyema. In rare instances a cavity may ulcerate through the chest wall and be mistaken for empyema.

Amyloid Disease.—This usually affects several organs simultaneously, particularly the spleen, kidneys, intestines, liver, and stomach. Amyloid disease is said rarely to curtail life. Watch-glass nails are said to occur.

Diabetes Mellitus.—This is frequently complicated by pulmonary tuberculosis, (16 per cent., Fitz and Murphy), which formerly ran a fatal and usually acute course. It is exceedingly rare for diabetes mellitus to occur in pulmonary tuberculosis. Hemoptysis is rare; the sputum may contain sugar, the sweats are less abundant and the temperature less elevated in pulmonary tuberculosis when associated with diabetes mellitus. Diabetes insipidus occurs very rarely in tuberculosis.

Carcinoma.—The age incidence and localization of the two diseases are so different that any apparent antagonism is easily explained. Schwalbe reported 3 cases of cancer developing in the wall of a tuberculous cavity, and Claude thinks that tuberculosis is not uncommon in cancerous deposits. Riffel holds the view that pulmonary tuberculosis is not more common in individuals with cancerous antecedents. One of my patients with pulmonary tuberculosis developed a primary carcinoma of the affected portion of the lung.

Syphilis.—A history of syphilis is not uncommon in patients with pulmonary tuberculosis. The lues is more frequently contracted first, and no doubt often plays an important part etiologically in regard to the pulmonary tuberculosis. Intensive specific treatment affects the tuberculosis little if at all.

Vaccination.—It is well to avoid vaccination in the advanced stages, and safer in all cases where practicable to isolate the pulmonary patients but it has little effect on the tuberculosis which in turn does not affect it. This is true also of typhoid fever and pulmonary tuberculosis. Antityphoid inoculation may be given without danger.

Diphtheria.—The age incidence of diphtheria and the comparative rarity of the exposure of consumptives to the disease account for their infrequent coëxistence. The patients should be kept in bed out-doors,

and antitoxin used as in ordinary cases. In an institution, prophylactic doses of 500 units should be repeated every two weeks as long as necessary. Caution is necessary when the pulmonary tuberculosis is complicated by enlarged lymph nodes.

Rheumatic Fever, etc.—Patients with pulmonary tuberculosis rarely have rheumatic fever. Indefinite pains in the joints are common, myalgia not infrequent, but arthritis is rare. West thinks an antagonism exists between the two diseases. The writer has seen but 1 instance in 2000 cases. Gout is rare with pulmonary tuberculosis, and some antagonism is said to exist between them. The age incidence is also different. Furthermore the gouty are well nourished and have a vigorous constitution. Poncet called attention to a tuberculous arthritis in tuberculous patients which often results in ankylosis. It is most frequent in children between seven and twelve years of age. It is distinguished from rheumatic fever by its mode of onset, by the slight general and predominant local symptoms (persisting in the joint affected), by the inefficiency of the salicylates, and by infrequency of cardiac complications. Arthritis deformans of the spine may occur with pulmonary tuberculosis, and suggest tuberculous spondylitis.

Addison's Disease.—This is a rare complication and only 2 patients out of 2600 at the Trudeau Sanatorium had the disease.

Pregnancy and Parturition.—Pregnancy often occurs in pulmonary tuberculosis. Bacon pointed out that pulmonary tuberculosis is at least as frequent in pregnant women as in the general population. From 1 to 1.5 per cent. (about 30,000 in the United States) of all pregnant women may be said to have a discoverable tuberculous lesion (Bacon), and West states that pulmonary tuberculosis is more prevalent among married than unmarried women. The effects of pregnancy and parturition upon pulmonary tuberculosis are to be separated. *Pregnancy*, if it causes no nausea or vomiting, often seems to exert little if any influence upon the pulmonary disease. In a few cases the disease is apparently arrested and the nutrition and general and local condition of the patient are improved during pregnancy. In acute progressive cases pressure of the enlarged uterus may cause discomfort and dyspnœa; the cough and fever may produce abortion, which, however, occurs far less frequently than in heart and kidney disease. Conception can occur at almost any stage of pulmonary tuberculosis.

The effects of *parturition* are always to be regarded seriously. After labor or abortion the pulmonary tuberculosis may run a rapid course and more often so if tuberculous laryngitis is present. The prolonged muscular exertion, the loss of blood, the exhaustion, and the possibility of the inhalation of infectious material are always serious. The indifference of many physicians to these facts is astonishing.

Pregnancy (including labor) may awaken old, quiescent lesions, and incite fresh ones to renewed activity. In advanced cases pregnancy is always serious, and when laryngeal lesions are present, the mortality is said to be 61 per cent. (Fellner). Multiple pregnancies even in cured patients are dangerous.

DIAGNOSIS OF TUBERCULOSIS

In no disease is diagnosis more important, for not only the immediate, but the permanent results of treatment are closely connected with and dependent upon the stage of the disease in which the diagnosis is made. He who always waits for tubercle bacilli to appear in the sputum or for rales before making a positive diagnosis is likely to come to the conclusion that many cases of pulmonary tuberculosis have slight chances of recovery. Personal acquaintance with a patient or his family should have no negative value in diagnosis.

Source of Infection.—The discovery of a source of possible infection at any age is an important point that needs careful investigation. This is the most important information in the family history, and a mere enumeration of the deaths in the family from tuberculosis, without exact details of the contact of the patient with the afflicted members is of small value. The habitation, workshop or office, and particularly the fellow-lodgers or employees, should be recalled by the patient to trace a likely source of infection. This is, if present, valuable in diagnosis, but its absence is of no great importance.

Predisposing Factors.—Due regard should be paid to the occupation. Great mental anxiety, grief, worry, care, frequent parturition and prolonged lactation, alcoholism, excess in venery, insufficient food, exposure to cold, unsanitary surroundings, and such diseases as measles, whooping cough, and smallpox, are all of importance. A history of previous adenitis or joint disease is of much value.

Symptoms.—In many instances these play a very important part in diagnosis and appear usually before physical signs are manifest in the lungs. Many patients lose their chances of recovery by the dilatory practices of some physicians. Suspicious symptoms should put us on our guard, and after due consideration, if explained fully in no other way, steps to be mentioned later should be taken at once to settle definitely the diagnosis. The localizing symptoms, such as hemoptysis, cough, and pleurisy, have greater diagnostic value than general symptoms such as rapid pulse, fever, loss of weight and strength. When two or more are combined it is suggestive of tuberculosis, and if associated with hemoptysis it is sufficient to subject a patient to treatment. Any of these symptoms following measles or whooping cough are always of grave import. Persistent, obstinate hoarseness or the history or presence of ischiorectal abscess or fistula always suggests a careful pulmonary examination, even if only slight symptoms are present. Preëxisting tuberculous lesions indicate a similar course. A combination of loss of weight and strength, fatigue after slight exertion, and loss of appetite, are usually embraced in the term "run down," and together with a slight cough form one of the commonest onsets. Stiffness and pain in the joints are sometimes present early. Oppression under the sternum, sometimes quite marked, and indefinite pains in the chest, especially between the scapulæ, are far from rare. The menstruation may be early affected, and later may entirely cease.

Fever.—The temperature plays an important part in diagnosis. Exercise may cause a rise of temperature (Penzoldt's reaction) in tuberculous patients, but is not of great value in diagnosis. The patient may be kept quiet for three or four days, then allowed exercise. A comparison of the temperatures during the two periods may aid in the diagnosis, but other debilitating diseases may act in a similar manner. In healthy women the temperature of the premenstrual period not infrequently reaches 99.5° or higher. In some nervous or fat individuals, as well as during convalescence from infectious fevers, the temperature may be easily elevated.

A persistent slight fever without apparent cause is very suspicious and should always be fully investigated. In some cases a persistent afternoon temperature of 99.5° to 100° F. is the earliest symptom. Disturbed sleep and a slight tendency to sweat may be the only signs of fever.

Loss of Weight.—This occurs in the majority of all patients. It is a striking fact that at the Trudeau Sanatorium the average weight of the patients on discharge, after an average gain of about 14 pounds, and while considerably above their weight in health, is no more than it should be normally. In other words, the consumptive is a person whose weight in health is considerably below the normal.

Loss of Strength.—Loss of strength, usually insidious in its onset, may first attract the patient's notice but other causes of general weakness, must be excluded. Slight loss of strength, expecially when coupled with localizing symptoms, is, at least suggestive.

Cough.—This is the most frequent early symptom and nearly always the one which first draws attention to the lungs. A slight persistent hacking cough, often dry at first, and occurring possibly only after a deep breath, should receive careful attention. It often has periods of marked remission, so that the patient believes he is recovering from the "cold," and may give a history of "colds," repeated over a long period. A summer cough is always more suspicious than a winter cough.

Hemoptysis.—In nearly all cases a period of more or less pronounced ill-health precedes the so-called primary hemoptysis. The first point to be considered is the source of the blood. Blood from the nasopharynx may be mixed with mucus, but usually some epistaxis is present. It may come from varicose veins at the base of the tongue or on the posterior pharyngeal wall. Bleeding from the larynx, unless it is seriously diseased, is of such rare occurrence that it need not be considered. A careful examination of the mouth, gums, nose, and throat should always be made if any doubt exists. The amount of blood from these sources, when there is no epistaxis, is usually slight. It is rare for a hemorrhage of over 1 ounce to come from elsewhere than the lungs, stomach or nose. Slight blood-spitting following cough on several successive mornings is characteristic of hemoptysis of tuberculous origin. It is rare in pulmonary tuberculosis to have a brisk hemoptysis not followed by blood-stained sputum for a day or longer.

The bloody sputum should be fully examined. A uniform pink or bright red, watery fluid, consisting almost entirely of saliva, comes usually from the gums or mouth and may be present for months. It should not

Datael pulm. lumpt. due to pericarditis nodosa : Stanbury
J. a m a 1925, 1643.

be confused with wine, tobacco, prune juice, licorice, or medicine. Streaks of blood upon the mucus or upon masses of sputum usually come from the bronchi, and are not uncommon in bronchitis after severe coughing. Uniform pink, red, rusty, or darker (prune juice) viscid pellets, containing minute air bubbles, occur in pneumonia (most common), heart disease, and pulmonary tuberculosis. Small purple or dark lumps without air bubbles which sink in water are usually due to heart disease. Pure blood in some amount, if it is frothy, is usually from the lungs, trachea, or bronchi, and if mixed with mucus or pus is unquestionably from the lungs. The blood of hemoptysis may be swallowed and then vomited.

When it is determined that the source of the blood lies below the larynx the next step should be to exclude all extrapulmonary disease which might cause hemoptysis. Among these are ulceration of the trachea (rare), heart disease, aneurism, certain diseases of the blood (purpura, hemophilia, scurvy, leukemia, pernicious anemia, the malignant type of some infectious fevers), atheroma of the pulmonary vessels, and abscess of the liver (perforating through the lungs).

Having excluded all sources of the hemorrhage except the lungs, these organs should receive due attention. At least 90 per cent. of all patients who have hemoptysis develop at some later time pulmonary tuberculosis. Every patient who suffers from hemoptysis of a dram or more without a discoverable cause should be considered tuberculous until proved otherwise. The blood, and particularly any particles of pus or mucus, should always be examined for tubercle bacilli, which are found in a number of cases. The examination of the blood of hemoptysis for tubercle bacilli may be greatly facilitated by hydrohemolysis, the addition of 12 to 20 volumes of water or of one-third volume of alcohol to the blood before centrifugalization. Slight general and local symptoms with an undoubted history of hemoptysis justify a diagnosis of tuberculosis. Hemoptysis may occur in bronchitis (especially fibrinous), bronchiectasis, gangrene, abscess, asthma, emphysema, lobar pneumonia, infarct, embolism, anthrax, syphilis, actinomycosis, spirochetosis, parasitic diseases (echinococcus, distomum), tumors (carcinoma, sarcoma), in trauma of the lung or air passages, and in fact to a slight amount in nearly every pulmonary disease. The physical signs in these cases are usually well-marked. Hereditary hemoptysis has been described (Libman) as well as bleeding from varices of the lungs and trachea. Vicarious menstruation has rarely been proved to occur in normal lungs.

In the presence of hemoptysis of a dram or more the absence of physical signs, unless supported by negative roentgen-ray findings, is of little value in excluding pulmonary tuberculosis. Hemoptysis, associated with or following pleurisy with effusion, demands a positive diagnosis.

Dyspnœa.—This is sometimes the first symptom but it rarely occurs to such a degree that a physician is consulted before other symptoms set in. Unaccountable dyspnœa or a sudden attack of asthma is suspicious.

Pleurisy. Most idiopathic pleurisies are tuberculous. If other organic disease can be excluded, the pleurisy should be considered tuberculous until the contrary is proved. A dry pleurisy at one apex or a double pleurisy without other cause is nearly always tuberculous. Even if

tubercle bacilli cannot be found in a pleuritic effusion it is well to assume the patient to be tuberculous, and to treat him accordingly. Such a patient should be kept for some weeks at rest if a parenchymatous roentgen-ray lesion is present. A persistent feeling of pressure in the chest demands careful consideration.

Physical Signs.—The value of physical signs must not be overestimated. A large central lesion can exist without discoverable physical signs, their absence is not astonishing. Marked physical signs are not to be expected in early cases, and any change from normal may become evident only after repeated examinations. At least two examinations are necesary before the chest can be said to be normal in regard to physical signs. On the second examination those places should be first examined which were suspicious on the previous examination.

Percussion yields little aid in some patients in early stages, but when the disease is of some duration its value is markedly increased. Slight differences should be checked by repeated examinations and after a full inspiration. Absence of dulness may occur even in advanced cases and hyperresonance should receive careful attention. Emphysematous changes may produce a relatively low note on the affected side. The right apex usually reaches a slightly lower level than the left, a point of no great importance. Changes in the movement of the bases of the lungs and in the resonant areas above the clavicles may aid in diagnosis.

Auscultation undoubtedly yields the most trustworthy information and in many early cases it gives the only change in the physical signs. It should be practised before the patient is made to breathe deeply, and on a second examination the auscultation of the suspected area should be the first procedure. Slight changes in the breath sounds at the right apex are often difficult of detection. They are of more value if at one apex, and if present at both the patient should be made to breathe noiselessly through his mouth, and the presence of stenosis of the larynx or bronchi by pressure from aneurism, tumor, enlarged glands, or traumatism excluded. Prolonged high or low-pitched expiration, or spluttering of the inspiration, suggesting fine crepitations which, however, cannot be heard, wavy breathing, weakened breathing, are all signs of great importance when limited to one apex. Wavy breathing must be carefully separated from the cardio-respiratory murmur. A venous murmur above one clavicle may suggest loss of vesicular murmur until the patient holds his breath. The whisper should *always* be auscultated over the entire chest, as in some instances it will first draw attention to the diseased area.

The change in breath sounds alone is rarely sufficient for diagnosis, but moderately coarse rales persistent or occurring on several examinations above the third rib and third dorsal vertebral spine on one side, not due to influenza, and coupled with slight symptoms, border on certainty. Rales are more important than dulness and are frequently overlooked through failure to have the patient cough and breathe properly. They may be present one day and absent the next, to recur on the following day. They are more likely to be heard on damp days than on dry, in the morning on waking than during the afternoon. Iodide of potash, certain alkaline mineral waters, tuberculin, and menstruation may in-

H. Maendl: U. d. diag. Bedeutung d. menstruellen Hyperämie
f. d. Diag. der Sterilität. W. kl. W. 1923, 36; 487.

crease the rales, while excess of alcohol (Turban), certain drugs (balsam, tars, etc.), profuse sweating, or prolonged dry, following damp, weather may decrease the rales. Rales may be heard in the prone and not in the upright position, and Upham believes when lying on the affected side rales may be heard that otherwise escape detection. Cybulski's laryngeal crepitations (oral rales) occur usually too late to be of any diagnostic aid.

Extraordinary care must be exercised in differentiating various sounds heard in the normal chest from rales: (1) *Skin friction sounds* are often heard just after the stethoscope is placed upon the chest, and slight pressure applied to it as the patient begins to inhale. A second breath or cough before moving the stethoscope or dipping the bell in water or vaseline will often eliminate these sounds. (2) The sounds produced in the *muscles* may resemble a hum, a fine crackle, or, if one muscle slips over another, a snap or friction sound. Such sounds are usually heard on the back, most often on both sides, but may be limited to one, and call for much experience in differentiation from fine rales. (3) A sound produced on *swallowing* resembling fine rales may cause some confusion, but is easily prevented by a word to the patient. (4) Sounds produced in the *stomach* and *intestines* can be heard over the lower part of the lungs and seldom cause error. (5) The *peritoneal friction rub* is rarely a factor worth considering. (6) *Tendon* and *bursal* sounds occur usually above the third vertebral spine, and at times closely simulate a pleuritic rub. (7) The occurrence of *rales* in the normal chest is a mooted point. Atelectatic rales unquestionably occur over the base of the lungs posteriorly, but these quickly clear up. Marginal sounds or rales may occur at the bases in health. (8) *Sternal sounds*, heard over the second costal cartilage.

The location of the physical signs is the most important point in diagnosis. Pulmonary tuberculosis usually attacks the apex first, and persistent physical signs localized in the apex of one lung should always be considered tuberculous until the contrary is proved. The opposite is true of physical signs at the base. Primary basic tuberculosis may occur (3 in 100 cases, Rosenblatt), but basic tuberculosis is usually secondary to an older apical lesion. A secondary tuberculous infection of a non-tuberculous basic lesion may take place.

Scattered rales over a side with bronchophony and without dulness or other signs are nearly always due to tuberculosis (Williams). This is also true of pleuritic friction sounds at one apex or on both sides in the absence of other causative factors. In early childhood the resilience of the chest walls and the dissemination usually render diagnosis from bronchitis or bronchopneumonia difficult. Examination of the stools for tubercle bacilli should be made. In old age prolonged expiration, jerky breathing, and even a few dry rales are of less import than in adult life unless limited in area. Symptoms are of much importance.

Contraction or atrophy of certain muscles (pectoral, sternocleidomastoid, trapezius, etc.) may at a glance or on palpation suggest disease at one apex (Pottenger).

A change may occur in the pulse-rate when the patient assumes an erect posture. The pulse may have a low tension but its increased

frequency is the most important factor. A persistently high pulse without fever, with loss of weight, is suggestive of tuberculosis.

Neither physical signs nor symptoms alone are sufficient in many cases for diagnosis; but the combination of slight signs and symptoms with a positive parenchymatous apical roentgen-ray lesion, will often settle the matter. Slight or indefinite physical signs without symptoms are not sufficient to establish a diagnosis.

Roentgen-ray.—Properly taken stereoscopic plates are as important in diagnosis, when intelligently read, as the study of the physical signs. Poor plates or careless interpretations are dangerous. It requires as much study to interpret accurately roentgen-ray plates as it does to acquire proficiency in physical examination. A definite and characteristic mottling above the third rib and third vertebral spine suggests pulmonary tuberculosis and is rarely due to any other condition. Tuberculosis may produce similar mottling elsewhere but here other conditions are likely to lead to confusion. It is dangerous to attempt to interpret mottling near the heart.

Sputum.—The rule to examine the sputum of every patient who has any respiratory affection, slight or serious, admits of no exception. If the patient says he has no sputum, a specimen obtained by clearing the throat in the morning or after meals should be requested. The macroscopic appearance of the sputum is of little value, and the absence of tubercle bacilli is no proof of the absence of pulmonary tuberculosis. One positive examination, which should be confirmed at once, settles the diagnosis, but several negative examinations are of less value. Elastic tissue in the sputum is evidence of destruction of the pulmonary tissue. Tubercle bacilli may be absent on repeated examinations when the disease has become fibroid, but the absence of these bacilli when the lung is breaking down or has undergone extensive destructive changes is presumptive evidence that the disease is non-tuberculous. Tubercle bacilli may be found in the sputum months before physical signs appear in the lungs. They undoubtedly find their way into the nasal and buccal secretions and have been discovered there in healthy individuals. For this reason one tubercle bacillus is not sufficient for a diagnosis. In children or in patients who are suspected of swallowing the sputum a careful examination of the vomitus, stomach contents, a swab of the fauces, or of the feces by Schone and Weissenfels' modification of Reh's method (mixing with antiformin, sedimenting, mixing the top layer with 3 or 4 parts of 95 per cent. alcohol, centrifugalizing and staining the sediment) should be made. The expectoration of calcareous matter rarely if ever occurs except in tuberculosis of the lungs or of the bronchial glands. The inoculation of sputum into a guinea-pig may reveal tubercle bacilli that cannot be found by careful and repeated examination, but a negative result does not exclude the presence of tubercle bacilli in other specimens. Potassium iodide in some cases increases the bronchial secretions, and tubercle bacilli, absent previously, have been found in the sputum following its administration.

Sputum Examination.—The chief value of this is for diagnosis. Its prognostic importance has been greatly exaggerated and no practical

Peltason: Compression of pulm. apex, an aid to improvement
of fluoroscopic. Portable. q.d. Gb.D. Roentgenologie 14 23,30; 283-287

method has been devised by which secondary infection can be accurately diagnosed. The diagnosis in most cases should be made before tubercle bacilli appear in the sputum. The *collection* of sputum is very important. It is surprising how often tubercle bacilli occur in patients who have "no" sputum. The morning sputum should be obtained when possible and the specimen should always be coughed up from below, not drawn down from the nose. Patients with little sputum should be told to bring the little dense, tough balls they raise at infrequent intervals. These are often the only parts of the sputum to show tubercle bacilli, and great stress should be laid on their collection. Tubercle bacilli stain well in putrefying sputum after three months or longer.

The blood of an initial hemoptysis should always be examined for tubercle bacilli, and, if none are found, inoscopy or hemolysis should be carried out. No sputum should be said to be free from tubercle bacilli until it is negative on at least three successive days, or the concentration method used on all the sputum collected for three days.

The sputum in pulmonary tuberculosis has no pathognomonic *macroscopic* appearance. Early in the disease the sputum is largely mucoid, more or less transparent, and with an occasional fleck of yellow pus. As the disease advances it may become white, contains less air, and finally assumes a yellow or yellowish-green appearance, occurs in masses (nummular sputum), and sinks in water. With improvement, the sputum becomes less yellow, then white, and finally consists of glairy mucus, which may persist for years. Macroscopic particles of lung tissue are occasionally found in the sputum and usually consist chiefly of elastic tissue. The presence of actinomycotic granules and fungi should be excluded. The albumin test (made with heat or nitric acid with sputum from which the mucin has been precipitated by acetic acid and filtered off) is always, some claim, positive in pulmonary tuberculosis; it occurs also in all inflammatory pulmonary conditions but not in simple bronchitis.

Quantity.—This varies from the slightest trace to 800 cc. in twenty-four hours, but rarely exceeds 100 to 125 cc. a day. As a rule, in the earlier cases the sputum is small in amount, increases as the disease advances, and is seldom absent when symptoms have continued for two months or longer. While the disease is undergoing arrest, the sputum usually diminishes and may disappear. Sudden changes in the amount call for a careful examination, as a sudden decrease sometimes occurs in acute miliary tuberculosis and in temporary heart weakness or intercurrent diseases. Miliary tuberculosis is at times ushered in with a sudden increase of the sputum. In many cases the morning sputum is the first to appear and the last to disappear.

Consistency.—This varies from that of water to sputum so tenacious that it will remain in an inverted cup. The sputum ordinarily is moderately tenacious.

Lung Stones.—Chalky concretions are usually found in the sputum of chronic patients with rapidly advancing ulceration. Kidd believes that they are nearly pathognomonic of pulmonary or glandular tuberculosis. They are uncommon (16 among 1000 cases, Williams), and usually

occur singly from time to time (500 from one patient). Their size varies from that of a small shot to a cherry. They are generally irregular in form, with numerous rough projections and usually white. They are formed in the lungs and glands from calcification of caseous masses, and it is said "in obstructed bronchi," but this is doubtful. They are frequently associated with or preceded by hemoptysis.

Variations According to the Type of the Disease.—In acute pneumonic phthisis the sputum is at first similar to that of acute pneumonia. Later it takes on a greenish tinge. Such a change in an unresolved pneumonia is always suspicious. Acute miliary tuberculosis of the lungs may occur without sputum. If secondary its onset may be marked by a sudden diminution of the sputum or by a change to a watery consistency and a marked increase in the amount. An attack of acute bronchitis may decrease the sputum temporarily to increase it later.

Microscopic.—The examination of a fresh specimen may reveal elastic tissue. In every case when tuberculosis is suspected and no tubercle bacilli are found, examination of the fresh sputum should be made.

Selection of Particles.—Search should be made for the little flecks of pus or cheesy particles which are readily seen on a black background. The wooden specimen box, painted black, is excellent (Hart).

Cells.—The cellular elements of the sputum include pavement epithelium, alveolar, ciliated, glandular, cylindrical, pus, red blood, and giant cells. In some cases the cells may be pigmented.

Elastic Tissue.—Dettweiler's maxim, "Where elastic tissue is, there are also tubercle bacilli," is still held in part, but its converse cannot be affirmed, as many specimens contain tubercle bacilli and no elastic fibers. Tubercle bacilli always occur first. Elastic fibers are the surest sign of extensive destruction of pulmonary, bronchial, or tracheal tissue. Their constant presence shows advancing disease. They are absent in acute processes until the walls of the bronchi are broken down; 90 per cent. of all cases in which elastic tissue occurs are said to be tuberculous. Elastic fibers may occur for one or two years without signs of cavity formation. They are seldom looked for today.

Various crystals may be found in tuberculous sputum. Fibrinous coagula, striking tree-like bodies, may occur in phthisis as well as in fibrinous bronchitis. Casts of the bronchi also occur, and it is not very rare to find the blood coagulum after an hemoptysis in the form of a cast of a bronchus. Caseous matter may be found.

Tubercle Bacilli.—The search for tubercle bacilli in the stained specimen is the most important step in the examination of a suspected person. Many new stains have been introduced, but none has stood the test of time as the carbol-fuchsin method. Cover-slips or slides may be used but on the whole slides are more satisfactory. Only new slides or slips should be used in specimens for diagnosis. In routine work much time is saved by using the "cold" method. This consists in immersing the preparations in the cold stain for twenty-four hours.

Decolorization.—Acid alcohol and Ebner's decalcifying fluid (HCl, $NaClO_3$, of each 2.5 parts dissolved in 100 parts of distilled water and 500 parts of 95 per cent. alcohol added) are excellent. Tubercle bacilli

Bacteria counterstain greatly facilitates finding J.B.
lesions. Ehrlich 0.1% aqueous sat. picric acid equal parts.
Journ. confirms (ob. for book 1925, 66);

resist this for ten or more minutes. The tubercle bacilli are to be well stained in the first place and then carefully decolorized, controlling this step in important cases by frequent examinations under the low power of the microscope. This cannot be done if a counter-stain is added to the decolorizing agent, and, therefore, Gabbett's solution (2 per cent. methylene blue in 25 per cent. H_4SO_2) should never be employed for diagnosis or in any case for urine. For routine examinations in sanatoriums the use of Gabbett's solution is permissible after diagnosis, but is not recommended, as every specimen should be subjected to alcohol and counter-stained with methylene blue.

Diagnosis from Other Acid-fast Bacilli.—A large number of "acid-fast" bacilli have been found, but so far none resists alcohol to the same extent as the tubercle bacillus. The only absolutely certain method is to control the decolorization by subjecting tubercle bacilli placed on the same slide to exactly similar manipulations. The majority of the acid-resisting bacteria grow readily and quickly on the usual media, often at room temperature. Inoculation of guinea-pigs may have to be employed. In most instances these bacilli differ morphologically from the tubercle bacillus, and are usually longer or shorter and broader. They occur in butter, milk, smegma, contents of tonsillar crypts, cerumen, nasal secretions, in the sputum of some cases of gangrene, bronchiectasis, and putrid bronchitis, in manure, and on timothy hay.

Examination.—This should be done systematically and thoroughly with a mechanical stage, and at least two preparations from each specimen should be examined. Much time can be wasted by counting tubercle bacilli in the preparations, but a schema such as that devised by Gaffky is of considerable value in comparing the findings from time to time. It is as follows:

1. Only 1 to 4 bacilli in whole preparation.
2. Only 1 bacillus on average in many fields.
3. Only 1 bacillus on average in each field.
4. 2 or 3 bacilli on average in each field.
5. 4 to 6 bacilli on average in each field.
6. 7 to 12 bacilli on average in each field.
7. Fairly numerous on average in each field.
8. Numerous on average in many fields.
9. Very numerous on average in many fields.
10. Enormous masses on average in many fields.

In this a No. 3 ocular with 16 mm. tube length and $\frac{1}{12}$ oil-immersion lens should be used. The fallacy of basing conclusions upon the number of bacilli is seen when the uncertain distribution of bacilli in the sputum is kept in mind. A number of methods devised to determine accurately the number of bacilli are of little practical value.

A study of the sputum of 259 cases at the Trudeau Sanatorium showed that when the diagnosis was made before tubercle bacilli were present in the sputum, *i. e.*, before ulceration, the chances for recovery were at least twice as good and on the whole seemed many times better; that only 44 per cent. of the patients with tubercle bacilli on admission had lost them on discharge after about five months; that the number of bacilli

seems to vary on the whole directly with the severity of the case; that if the number of bacilli steadily decreases in a series of examinations at intervals sufficiently long, the patient may be improving, but the constitutional symptoms and local signs are much more trustworthy; that if on repeated examinations large numbers of bacilli are found, the disease has probably advanced to cavity; that the morphology of the bacillus affords little or no ground for prognosis, but the short bacilli are suggestive of a more active process; and that the arrangement of the bacilli in clumps may occur in all, but is more common in the severer cases.

Splitter sputa, fine, generally long granules, arranged in a row or in groups, Spengler believes are involution forms of tubercle bacilli and may be found when no "normal" tubercle bacilli can be seen. Such sputum is not always infectious to guinea-pigs. Much's granules are of little diagnostic aid in sputum. The tubercle bacilli usually occur free, but may be found in pus or alveolar cells.

Secondary Organisms.—A diagnosis of secondary infections, on account of the rapid growths of the organisms, cannot be made from sputum examined several hours after expectoration. The mouth should be thoroughly cleansed before collecting the specimen and the sputum, not later than fifteen minutes after it is expectorated, should be carefully washed in three to ten changes of salt solution. The mass should then be torn apart and a piece of sputum from the middle of the mass examined. Secondary infection should be diagnosed only after repeated examinations, and even then clinical symptoms have often to be relied upon.

In the ordinary examination of sputum, streptococci, staphylococci, diplococci, torulæ, sarcinæ, and bacilli, singly, in chains, or in zoöglea masses, occur more or less frequently. A biscuit-shaped diplococcus resembling the gonococcus is common. The pneumococcus and Freidländer's bacillus are less frequent.

Methods to Increase the Number of Tubercle Bacilli in the Specimen to be Examined.—The one most frequently employed is to render the sputum more or less homogeneous and then to sediment or centrifugalize it. Antiformin, best prepared by mixing, just before use, equal parts of Javelle water and 15 per cent. sodium hydrate, is an excellent solvent for the sputum or better a 4 per cent. solution of NaOH, as advised by Petroff, may be used. After treatment the sputum can be centrifugalized and examined. A fixative such as egg albumen or some of the original sputum must be used with these methods. Inoscopy has been successful in some cases.

Another less satisfactory procedure is the "enriching" of the specimen. In ordinary sputum at room temperature or even in the thermostat, little or no increase of the tubercle bacilli can be found. The addition of some culture medium to the sputum seems to aid little in the growth of the tubercle bacillus. Cultures directly on blood serum from sputum treated with antiformin (Brown and Smith) or on gentian violet media by Petroff's method, may reveal tubercle bacilli in specimens, even when none was found by ordinary staining methods. A marked increase in the number of these organisms at 30° C. in ordinary bouillon is conclusive proof that the organism is not the tubercle bacillus.

Injection into Animals.—Sputum in which no tubercle bacilli can be found, which on inoculation produces no tuberculosis in four to six weeks, contains no tubercle bacilli. The sputum should be injected, as soon as possible after it has been collected, subcutaneously in the groins of two guinea-pigs and the animals examined from time to time for enlarged inguinal lymph glands. At the end of four to six weeks the animals should be killed and any enlarged glands thoroughly examined for bacilli or for tubercles, macroscopically and microscopically. Some regard intraperitoneal inoculation as more sensitive than subcutaneous. Nattan-Larrier advises inoculation into the mamma of a guinea-pig, one or several days after delivery. Tubercle bacilli are said to occur in the milk on the fifth to the tenth day. Heating the sputum to 60° C. for ten minutes may destroy many secondary organisms which may be virulent for the guinea-pig without affecting the tubercle bacilli. Pseudo-tubercle bacilli can produce tubercles, but cultures separate the two forms. To attempt to determine the virulence of a strain of tubercle bacilli by injection of animals with sputum is futile, unless the number of bacilli in the injection can be controlled.

Urine.—The urine is of slight value in diagnosis. Albuminuria is exceedingly rare in incipient cases. Polyuria is uncommon. The auto-urine test is not specific.

Serodiagnosis.—The sedimentation test (suspension stability) is of no value in the diagnosis of tuberculosis. Precipitation and sedimentation tests have proved of little value. Complement fixation is often of little aid.

Tuberculin.—Tuberculin, since the introduction of the skin test by von Pirquet, has been widely used. While tuberculous subjects react to substances other than tuberculin, the doses of tuberculin necessary for reaction are far smaller. It was formerly held that only tubercles produced by living tubercle bacilli would give a tuberculin reaction but recent work by Zinsser and Petroff has shown that dead bacilli or even some split products can sensitize animals (older guinea-pigs) to tuberculin. This is not of much importance in adult pulmonary tuberculosis, and tuberculin tests are now interpreted as meaning only infection of some gland or organ and not necessarily the organ under consideration. In several thousand cases at the Trudeau Sanatorium only 1 has failed to react to Old Tuberculin, full strength, when given intradermically. The subcutaneous test is now used chiefly in patients with slight or doubtful physical and roentgen-ray signs, and unless these signs increase definitely during the reaction, with or without increase of pulmonary symptoms, a positive general reaction is considered negative as far as the lungs are concerned.

The *cutaneous* test (Pirquet reaction) is performed by abrading the superficial layers of skin on the forearm over an area of 1 or 2 mm. in diameter or by a scratch with a scalpel until the pink corium is visible but no blood drawn, and then applying and rubbing in gently a drop of tuberculin (25 per cent. to full strength O. T. which is preferable). It can be wiped dry at the end of three to five minutes. A control abrasion should be made below, and both observed at intervals

for forty-eight hours or longer if no reaction occurs. A positive reaction consists in the appearance of a papule and erythema at least 4 mm. in diameter. The objection to the test is that it is difficult to determine how much tuberculin is absorbed.

In the *intradermic* test the needle is inserted into the superficial layer of skin so that the lumen of the needle can be seen. Usually the tuberculin in doses of 0.00002 cc. of Old Tuberculin to 0.001 or even 0.1 cc. is injected in such a quantity of salt solution that the volume never exceeds 0.3 to 0.5 cc. This test is considered more accurate but more unpleasant than the cutaneous for if injected too deeply it may cause a general reaction. As in the cutaneous test it should only be given twice a week. The erythema may be much more marked than in the cutaneous test.

Tuberculin in *ointment* (50 per cent. in lanolin) rubbed into the skin produces papules in a day or longer if a positive reaction occurs.

The value in diagnosis of these tests is confined to the first few years (five to seven) of life. In adults they indicate only that tuberculous infection has occurred. Measles, pertussis and influenza may cause a negative reaction for a time. In advanced tuberculous disease the reaction may be negative.

In sensitive individuals tuberculin applied to the *conjunctiva* produces a reddening of the conjunctiva especially about the caruncle. At times severe reactions may occur, and even ulceration of the cornea result. Notwithstanding that some hold that this ophthalmic test reveals activity of a lesion, it has fallen into disuse.

The *subcutaneous* test when positive produces unpleasant symptoms, though many patients state they feel better after it. A positive reaction reveals of course tuberculous infection but without a local reaction, called a focal reaction, tells nothing of the organ which gives the reaction. Hence the value in pulmonary tuberculosis of a careful study by physical and roentgen-ray examination of the lungs to see whether any changes have occurred during the reaction. The first dose, preceded by an injection of normal saline, is usually 0.0005 cc. Old Tuberculin which, if no reaction occurs, should be followed at three and four day intervals by 0.001, 0.003, 0.01, 0.01cc. The dilutions can be made with a tuberculin syringe with divisions of 0.01 cc. and normal saline containing 0.25 per cent. of phenol. The weaker solutions should not be kept over one to two weeks. Ordinary methods of asepsis should be observed in the administration.

The *reaction* usually occurs in eight to twenty hours, and the temperature should be taken for two or three days previously. During the test the patient should be kept quiet but not necessarily in bed. In a typical reaction the patient begins to feel indisposed in twelve to eighteen hours after injection, and rapidly becomes worse. Severe headache, general malaise, pain in the back and legs, loss of appetite, even nausea and vomiting and, in some cases, a tendency to cough and profound prostration occur. The temperature rises usually to 101° but may not go over 100° or may reach 107° F. Changes in the physical signs, an increase of rales or an increase of haziness about a pulmonary focus, may occur. The next day the temperature is usually normal, and the patient

Dodd & Brown (Can. Med. Ass. Jr Aug '26 p 937) Intracut. injections more sensitive than cutaneous. 9 in 72 pts, 16.5% neg to intracut. & 41.9% to cutaneous (74 pts).

may feel better than before the test. The sputum may increase, and tubercle bacilli may occur for the first time in rare instances. Marked general symptoms with a rise of temperature of 1° F. can be considered a positive reaction. With larger doses a clean cut reaction should be required. Changes during the reaction have been noted in the urine (diazo reaction, albumin), and in the blood (slight leukocytosis).

Some selection of cases must be made for the subcutaneous test. At one time at the Trudeau Sanatorium all patients without tubercle bacilli in the sputum were subjected to this test, and strange as it may seem now, no permanent harm resulted in any patient. One only suffered a temporary upset which was of no moment as today she is married and leading a normal life fifteen years after the test. At this institution the test is given now only when the physical examination reveals an indefinite parenchymatous roentgen-ray change. Patients with night-sweats, great dyspnœa, recent hemoptysis (within a month), general glandular involvement, meningitis, heart disease, nephritis, epilepsy, Addison's disease, and those with a temperature over 100° F., should be excluded.

A positive subcutaneous test means tuberculous infection, and tuberculous disease if a positive focal reaction is determined. Some completely encapsulated lesions may fail to react even when tubercle bacilli are present in the sputum. A positive reaction does not indicate that treatment is necessary, and many patients who react positively are each year returned home from Trudeau as having no pulmonary tuberculosis that needs treatment. Failure to react to a second dose of 0.01 cc. Old Tuberculin occurred in 41 of the Trudeau patients and none has ever relapsed or contracted pulmonary tuberculosis after five to twenty-four years. A patient with a doubtful parenchymatous roentgen-ray lesion and a negative reaction can safely return to a God-fearing life.

Diagnosis of Special Forms.—To separate these forms most reliance must be placed upon the history and symptoms, which alone in nearly every instance will determine whether the disease is acute, subacute, chronic or arrested, by the presence or absence, more or less continuous, of fever, night-sweats, emaciation, weakness, hemoptysis, dyspnœa, cough, and expectoration. The physical signs reveal the damage that has been done, the symptoms whether it is progressing. In a few cases the disease advances so slowly and with so few pronounced symptoms that only careful examinations repeated at long intervals will reveal its slow advance. Serial roentgen-ray examinations are invaluable for the detection of slight changes of the disease.

Acute Form.—The high temperature, continuous, remittent, or hectic, the rapid pulse, the hurried respirations with possibly an increase of cough and expectoration, and in some instances considerable cyanosis, all indicate an acute exacerbation. In some cases in this group the physical signs remain unchanged for some days.

Latent Form.—The physical signs may be indefinite and the symptoms only those of slightly failing health. In other cases the symptoms are latent and extensive physical signs are found.

Early Form.—In a considerable number of these cases the sputum contains tubercle bacilli, and while the symptoms may be pronounced the physical signs are often very indefinite. The diagnosis depends in many cases, when the sputum is negative, upon the typical symptoms, the absence of any other causative factor, and the roentgen-ray changes.

Advanced Form.—The marked signs, usually most advanced at the apex, and the typical symptoms render the diagnosis easy in most instances, but in some chronic fibroid types in which the expectoration is abundant the tubercle bacilli may be very difficult to discover, and only at postmortem can it be definitely separated from other chronic conditions. Most of the general and local symptoms are present, and in many instances tuberculous complications in other organs aid in the diagnosis. In 6 per cent. of 1200 cases, studied by McCrae and Funk, tuberculosis had been wrongly diagnosed. Tubercle bacilli must be positive on two examinations.

The diagnosis of activity is usually easy but in some cases may be difficult. A continuous rise of temperature, over 99° in a man, over 99.5° F. in a woman, a pulse-rate above 90 in a man, 96 in a woman, indicate activity if no other cause is found. A steady increase of the physical or roentgen-ray findings is also a sure guide. Fatigue, loss of weight and strength, and night-sweats, are suggestive. Slight cough and expectoration are no guide, and neither tubercle bacilli in the sputum nor hemoptysis are definite signs of activity. Rales may persist for years in inactive cases.

Differential Diagnosis.—Pulmonary tuberculosis is protean in its manifestations. Many diseases have been mistaken for it, and, what is in many instances more important for the patient, pulmonary tuberculosis has been mistaken for some other disease. We can divide the following diseases into two groups: First, those which pulmonary tuberculosis may simulate, and second, those which simulate it.

Under the first group belong malaria, typhoid fever, nervous dyspepsia, chlorosis, neurasthenia, and many pulmonary affections, such as simple bronchitis, influenza, idiopathic pleurisy, asthma, and acute, subacute, and chronic pneumonia and bronchopneumonia.

In the second group are latent suppuration, including endocarditis, pyorrhœa alveolaris, dental abscess and sinusitis, pernicious anemia, hyperthyroidism, Hodgkin's disease, and a number of pulmonary diseases, including influenza, bronchiectasis, pleurisy with effusion, gangrene, abscess, spirochetosis, foreign body, nocardiosis, pneumoconiosis, parasitic diseases, actinomycosis, tumor, syphilis, and pulmonary infarct. The following differential points are of importance. A suspected case without the plasmodium in the blood, with irregular chills and fever and which resists quinine, is not *malaria*. Bronchitis rarely complicates malaria. Acute pulmonary tuberculosis may closely resemble *typhoid fever*. The onset is very similar, and an initial bronchitis may occur in both. The temperature curves may show a continuous high fever, but oscillations are more frequent in tuberculosis. An important point is the cyanosis, which is more frequent in acute tuberculosis. The Widal test, if the patient has not had typhoid or been inoculated recently, may aid.

monilicosis (jaura 14 25, 55; 104

Pneumokoniosis: E. E. Collis (Med. Res. Council 1926, 13, 721–724)

Nervous dyspepsia is usually afebrile, and complete anorexia is not usual. Nervous dyspepsia, especially with a "stomach" cough, demands an investigation of the lungs and sputum. Many patients with anemia are really cases of early pulmonary tuberculosis. Neurasthenia in a mild form should always recall the insidious onset of pulmonary tuberculosis.

Persistent *simple bronchitis* is rare before the age of forty. Bronchitis occurs more frequently in winter, and fever is of short duration, dulness on percussion is absent, and the rales are diffuse. However, a patient convalescing from a sharp attack of bronchitis may present rales in one apex for a short time. Emphysema, common in chronic bronchitis, is rare in pulmonary tuberculosis unless the lesion is advanced.

Recurring non-tuberculous pulmonary infections, with the physical changes at the base, have been described by J. A. Miller and Garvin. Any symptom of pulmonary tuberculosis may be present.

Bronchopneumonia in an adult should be considered as possibly tuberculous even when sputum is absent. A tuberculous bronchopneumonia in children shows higher and more irregular pyrexia, more rapid and profound emaciation, and more sweating. Bronchopneumonia due to streptococci may show night-sweats, loss of weight, cough, intermittent fever, dulness and rales in the upper lobe with roentgen-ray changes simulating tuberculosis. The diagnosis in these cases rests solely upon the sputum examination. *Chronic pneumonia*, rather rare, can be diagnosed only by exclusion and after many negative sputum examinations. It is rare in tuberculosis to find advanced disease limited to one side. In simple chronic pneumonia the lesion is most pronounced at the base, in tuberculosis at the apex. The discovery of influenza bacilli or streptococci in a sputum repeatedly negative for tubercle bacilli bespeaks a chronic pneumonia. The number of cases of *idiopathic pleurisy* is reduced each year as more exact methods for the detection of tuberculosis are introduced. Pulmonary tuberculosis may attack an asthmatic, and asthma may set in early in pulmonary tuberculosis. It not infrequently follows an arrest of the tuberculous disease. The absence of tubercle bacilli and of localized changes, and the roentgen-rays separate the two diseases.

Latent suppuration may produce enfeebled breathing in the lungs, and many of the general symptoms of pulmonary tuberculosis. A leukocytosis should arouse suspicion and examination may reveal a suppurating focus in the appendix, tube, gall-bladder, or elsewhere. Localized empyema is usually basic and sputum is generally absent. Subacute endocarditis has been treated for months as pulmonary tuberculosis. The absence of changes in the lungs, the cardiac lesion, and the leukocytosis settle the diagnosis.

Hodgkin's disease with slight glandular involvement, high fever, prostration, and emaciation may closely simulate acute miliary tuberculosis of the lungs. A pleural effusion may occur. A definite diagnosis can be made only after careful study for some time, and in many instances is reached only at necropsy. Latent hyperthyroidism, with tachycardia, slight exophthalmos, some fever, pronounced weakness, and a marked

cardio-respiratory murmur offers considerable difficulty. The determination of the basal metabolism is important.

Syphilis of the lung may closely resemble tuberculosis, and the diagnosis rests upon the history, other luetic lesions, the results of antiluetic treatment, the Wassermann reaction, and the absence of tubercle bacilli. The root of the lung is more often involved, while the apex escapes. Destructive or diffuse sclerotic changes occur and some patients have fever and slight or indefinite pulmonary symptoms.

Bronchiectasis may so closely simulate tuberculosis that repeated sputum examinations are necessary to decide. Dulness is more apt to be lacking in bronchiectasis, and the base and posterior are more often affected. With bronchiectasis at the apex the diagnosis is difficult. Early hemoptysis favors tuberculosis, while copious expectoration in paroxysms, which is at times fetid, and without tubercle bacilli or elastic fibers, bespeaks bronchiectasis. Bronchiectasis is not uncommon in old tuberculous lesions. In pulmonary abscess or gangrene the large quantity of sputum at one time, its foul odor, its separation into layers, and the absence of tubercle bacilli, as well as the location of the lesion, usually basal, determine the diagnosis.

Some cases of *pleurisy with effusion* closely simulate pulmonary tuberculosis. One side may be affected and shrunken. Dulness is more or less marked, resistance increased, and auscultation reveals a distant respiratory murmur, possibly bronchial, with pleuritic friction sounds or numerous moderately coarse mucous rales widely heard. The symptoms may be the same as those of phthisis. Tubercle bacilli are absent from the sputum, and aspiration gives a thick fluid, perchance with many cholesterin crystals, or possibly a little pus if infection has taken place. Signs of cavity may be present.

The *parasitic* diseases of the lung most often confused with pulmonary tuberculosis are those caused by the lung fluke (*Distomum pulmonare*) and hydatids. The former is frequent in parts of Japan and is consistent with years of active life. The most important symptom is hemoptysis. The discovery of the eggs in the sputum or blood confirms the diagnosis. In hydatid disease of the lung the presence of the wall membrane or of hooklets in the sputum is pathognomonic. The distribution of dulness may be unusual and excite suspicion. The respiratory murmur and vocal fremitus may be absent. The upper lobe is usually involved. Eosinophilia may occur.

Actinomycosis is at times readily diagnosed from the sputum. It frequently attacks the chest wall. In anthrax the bacilli are found.

Streptothrix pseudotuberculosa (Flexner), *Cladothrix asteroids* (Eppinger), protozoan infection (Rixford and Gilchrist), and *Aspergillus fumigatus* (Renon), *penicillium* (Emerson), *spirochetosis* (Castellani) can all produce the same symptoms and physical signs as pulmonary tuberculosis. A careful examination of the sputum aids greatly in diagnosis.

Tumor of the lung more often simulates pleurisy with effusion than pulmonary tuberculosis, but at times it closely resembles a massive tuberculous consolidation. The abnormal position of the heart and the usual absence of fever are important points in separating it from tuber-

Bronchography very imp. Methods: 1. Oral - cocainize completely pharynx + palatine arch ē 10% - no adrenaline. Inform 15 to 30 cc lipiodol shown pt. drink, clear to side desired. 2. Inj eq. ½ sol 3 to 5 cc of 3% novocain to drink 1%. 2. Inject ē syringe into larynx, or by bronchoscope (vote bronchus 3. Inject thro cricothyroid membrane (good for upper lobes).

Churchill + Geo Holmes: Arch. Surg. 1927, 1044-1106 (May)
Obstruction of non-the. area on x-ray. 6 cases. Atelectasis 2° to foreign body, suppura. or chronic intrabronchial stagnation superimposed on a primary atelectasis. In 4 cases preceded by conditions that may produce massive collapse.

Spirochaetosis (Castellani, N. Orleans Med & S. Jr. July 1926) If serum one arsphenamine intravenously, if mild tartar emetic by mouth, Rx Tartar emetic gr iii, Syr. tolu ʒi, Eq. chloroform ʒ iii ʒi in aqua q 2 h.

culous disease. Pain and pleural effusion are common. Involvement of the glands may be of late occurrence in malignant growths. The sputum may resemble raspberry or currant jelly. Leukocytosis is often present. Replacement of the fluid by air may aid greatly in the diagnosis by roentgen-rays.

Slight *valvular insufficiency* may produce bloody sputum and, if infarct occurs, some temporary fever, pain in the side (pleurisy), rales, and possibly bronchial breathing. In some cases mitral stenosis has been regarded as pulmonary tuberculosis.

PROGNOSIS OF TUBERCULOSIS

The Basis for Scientific Prognosis.—Prognosis in the final analysis depends upon the number and the virulence of the infecting bacilli and upon the resistance of the patient, two factors about which our knowledge is most indefinite in any individual case. Furthermore, their influence cannot be separated one from another. The number of the infecting organisms can never be determined, but the virulence may be roughly estimated by animal inoculation. The resistance of the patient may be indicated by a limited lesion (resistance to the bacillus) even when the symptoms (fever, tachycardia, emaciation, etc.) are severe, or by slight symptoms (resistance to poison) though the signs may be very extensive. A double resistance is of course most favorable, and a resistance to poison is, on the whole, more favorable than a resistance to the bacillus, or it may be the latter is more easily acquired or more generally possessed than the former. There is a well-marked tendency to recovery in pulmonary tuberculosis, as postmortem statistics show. In a few patients in an advanced stage the disease shows a self-limitation and intrinsic tendency to recovery. Prognosis can be discussed in regard (1) to the danger to life, (2) to the curability, and (3) to the course and duration. The marked tendency to *relapse* is unfavorable, although relapse after some years of good health, during withch the patient has led an ordinary life, is only slightly less favorable than a primary attack. Relapse under favorable conditions is always more serious than under adverse, either in regard to work, hygienic or climatic conditions.

A limited experience often leads one to risk a positive prognosis, but with further knowledge and the recollection of numerous mistakes comes the humility of uncertainty. It is better in all cases to defer a prognosis until the patient has been observed for at least a month or until it can be seen how he responds to treatment. Gee has well said that he who would foretell when a consumptive will die can be sure of but one thing, that he will be mistaken. "In a disease where the unexpected so often happens, where the casual and unforeseen play so large a part, where the patient's wisdom, courage, and self-control count for so much, the prognosis should always be guarded, and a dogmatic attitude avoided" (Lindsay).

Age.—After the fourth semidecade of life, the prognosis with each year becomes less favorable, and after the forty-fifth year it is not good

for recovery, but the disease can usually be arrested or, if progressive, runs a slow course. Before the tenth or twelfth year lack of self-restraint would seem to, but does not, render the ultimate prognosis unfavorable. Acute tuberculosis is more frequent in younger patients. In the first year of life over 75 per cent. and during the second year over 50 per cent. of the patients die. From the sixth or seventh year to puberty the prognosis is as good or better than in later life.

Sex.—This, *per se*, seems to exert little influence. Just as the closer confinement to which women are subjected renders them more susceptible, so the ties and household duties which can be less easily avoided than the occupations of the males have a more serious effect. Marriage complicates the prognosis much more in women than in men, but under certain conditions may aggravate the prognosis in either sex. Puberty and the menopause are considered by some to have an unfavorable influence. Widowhood is serious for both sexes. Pregnancy may be considered the most important factor in regard to sex. Women with marked menstrual disturbances are less likely to do well.

Heredity.—The individual susceptibility is held by many to be inherited. It is believed to come from forbears weakened from any form of disease, not necessarily tuberculosis. In general, heredity seems to play a far less important part in prognosis than was formerly thought, and the general opinion today is that, once infected, heredity has little further bearing. Some believe that children of tuberculous parents and grandparents have increased resistance to tuberculosis.

Environment.—The present and future environment of any patient is far more important than the former surroundings. The latter, however, are not without influence, though this may be in part due to the bearing the former has upon the present or future occupation. Patients (males) with outdoor occupations do less well during sanatorium residence than those who have worked indoors. Patients from the country do not do as well as those from the city. The explanation no doubt lies in the greater change. Pulmonary tuberculosis contracted under bad environment is much more likely to do well, when the surroundings are changed, than when the disease occurs with good surroundings. The working classes, especially those who do manual labor, are likely to do much better if a "cure" has been effected at home, for in this case a suitable future environment is assured, which is not the case when the patient returns from a sojourn in a health resort or sanatorium to poor hygienic conditions and hard manual labor to support a family.

Patients who find light, agreeable employment without too much responsibility in suitable climates or in the country will do better. Those who return to a nagging wife or family ignorant of the proper treatment should receive a doubtful prognosis. The more nearly the future environment can approximate that under which the "cure" has been effected, the better the prognosis. Patients with ample means should, therefore, receive a better prognosis, but only if they fully realize that money is but an adjuvant, not a true means, to recovery. For all these reasons environment is probably the most essential factor in prognosis after arrest is once established.

Character and Disposition.—The habits are of great importance, and a methodical individual, not too lethargic, has always a more favorable prognosis. A former immoral, dissolute life indicates usually a harder struggle, but the prognosis is worse in those patients who have always followed only their own bent, irrespective of the wishes of others.

A bright, cheerful disposition betokens a better prognosis than a moody, morose, and taciturn temperament. Vacillation, lack of self-control, stubbornness, and lack of imagination or foresight are all unfavorable. The degree of intelligence is important. "I am impressed," writes Flint, "with the force of this statement, namely, most patients who recover from phthisis are persons of resolution and perseverence; persons who appreciate the nature of the disease and are determined to overcome it. The disease, as is well known, is apt to induce either delusions concerning danger or a state of passive acquiescence therein. The will may become here, as in some other diseases, an efficient agent in promoting recovery, and it is therefore an important element in prognosis. So far as the mind is concerned, the most favorable condition is that in which the patient appreciates fully the situation and is resolved to spare no efforts in becoming master of it, having much faith in his ability to succeed." Patients who have never been ill or who have always recovered rapidly from illnesses deserve more favorable prognosis. A previous susceptibility to catarrh and colds is unfavorable.

Mode of Onset.—A sudden onset is usually more favorable in that the patient consults the physician at once and does not wait until the disease is far advanced and symptoms pronounced. Patients with an insidious onset or even the catarrhal form may for the same reason present a more serious picture, although in itself the onset affords little aid in prognosis. The pneumonic, gastric, or laryngeal onsets offer usually a worse prognosis. A glandular onset generally betokens a chronic but not always a fatal course. An acute onset with extensive or marked physical signs is unfavorable, but the onset may be acute and the patient rapidly recover. An onset consecutive to some debilitating disease, *e. g.*, typhoid fever or measles, is often unfavorable. The mode of onset is connected with prognosis, chiefly in its bearing upon the diagnosis.

Weight.—Loss of weight at first is almost universal and if this approximates one-quarter of the body weight it is of grave import; if it reaches one-third, a fatal outcome is almost certain. A gain in weight under forced feeding is of less hopeful significance than a gain on an ordinary diet, but a rapid gain of some pounds is of vastly less moment than a steady but even smaller gain extending over a long period. A steady loss of weight is more unfavorable than continuous pyrexia, and if both continue when the patient is put under the proper treatment the outlook is particularly dark. In a few cases patients, often chlorotic, go steadily down hill, but lose little or no weight.

The *digestion* is the keystone in the prognostic arch. If it fails, the outlook is indeed gloomy. As long as it remains good and the patient can take sufficient nourishment there is hope. Patients who have always had a poor appetite, who have eaten little, usually have an unfavorable course (Brehmer). Patients with gastric ulcer often do remarkably

well. Marked cachexia is always grave and usually indicates severe chronic tuberculous intoxication.

Fever.—This is one of the most accurate indications of activity in the pulmonary lesion and for this reason is of vast importance. A temperature curve whose minimum never falls to normal indicates progressive disease better than any other signs. Continuous high pyrexia with marked remissions (as low as 93° to 97° F.) is usually indicative of septic absorption, cavity formation, and far-advanced disease, with little hope for permanent improvement. Subnormal oral temperature, if the circulation be good, is of no prognostic significance (especially in winter). Marked fever with slight physical signs, if of any duration, is always of serious moment. The inverse type of temperature curve is a most unfavorable sign. Persistent fever under suitable treatment is far more unfavorable than recurrent fever which quickly responds to treatment, but frequent attacks of pyrexia cloud the prognosis. As long as the nutrition is good there is hope of the fever subsiding. The prognosis is also governed by the time the fever has lasted, and even slight fever (99.6° to 100° F.) when persistent is ominous. The height of the fever is not of itself a bad sign. Collapse temperatures usually indicate approaching death. Absence of fever may mean immunity to the poison or lack of resistance.

Circulation.—The pulse in the majority is the best prognostic sign, and with the temperature and weight may be termed the prognostic triad. It is the most sensitive of the three, and the most easily affected by external conditions. A continuously fast pulse, not only in the office but at home, indicates a poor prognosis. A slow pulse with an elevated temperature indicates fever of recent origin or a favorable prognosis. A pulse constantly above 100 during rest is always serious, but a few patients, fully recovered, suffer for years from tachycardia. A pulse out of proportion to the fever indicates that the disease will advance in spite of the low temperature (Sirot). A pulse constantly above 110 indicates a fatal ending. Advanced cases with a normal pulse he found do better than incipient cases with a rapid pulse.

Cyanosis usually occurs only in desperate cases, but many patients with slight cyanosis, especially of the nails, may live for years and enjoy a fairly active life. Cyanosis following hemoptysis, especially with tachycardia and dyspnœa, is most serious and death usually occurs shortly.

The arterial tension usually falls in the later stages. Arteriosclerosis is unfavorable. In pulmonary tuberculosis associated with heart disease, the prognosis is that of the more pronounced disease. Patients with mitral disease do better than those with aortic disease. If compensation be good and the pulmonary tuberculosis slight, prognosis for life is good. Acquired dextrocardia is indicative of chronicity and is not in itself unfavorable.

Hemoptysis.—This may occur as an accident or as a symptom of an advancing process. The prognosis is very different, and when unaccompanied by fever, rapid pulse, dyspnœa or cyanosis, hemoptysis is often of little moment. Females do better than males. The so-called "hemorrhage cases," which are supposed by many to do better, have a slightly less favorable prognosis. Hemoptysis is rare in acute cases. In advanced

J. Cutler: Blood Sed. in U.S. Army in 1926, 161; 802
More rainbow than temp. rain, fair, or wet. Temp + mass
graphs. Continual diminution of rate favorable.

stages with cavity formation hemoptysis is always serious, but an absolutely hopeless prognosis should never be given.

Nervous Symptoms.—In prognosis the nervous system is second in importance only to the digestive and circulatory systems. In all patients in whom the nervous, neurasthenic, vasomotor, trophoneurotic or nervous dyspeptic symptoms are pronounced the prognosis is bad. In the mentally deficient, or even in those of a low grade of intelligence, the outlook is more serious.

Amenorrhœa.—This indicates in most cases advanced disease and is of serious import when continued over long periods. Return of menstruation is favorable, but little conclusion can be drawn from a continuance of this function, as it may persist to the end.

Urine.—*Albuminuria* from any cause, if more than transient, is of serious moment. Tuberculous nephritis, if confined to one kidney, may be recovered from, but greatly increases the danger.

Diazo Reaction.—If the patient has no kidney affection or has taken no drug which affects it, the constant occurrence of the diazo or urochromogen reaction may be considered unfavorable. The intensity of the reaction is of considerable importance. It is usually connected with fever, and occurs in some cases during the tuberculin reaction.

Blood.—This affords singularly little basis for prognosis. Increase of hemoglobin and of erythrocytes is usually favorable. In advanced cases a decrease of the leukocytes is unfavorable; an increase of the lymphocytes and transitional cells is possibly favorable. Arneth's index is of limited value. An increase of cells with fewer nuclei is held to be unfavorable, an increase of those with many nuclei of favorable import. The eosinophiles are of little value in prognosis. There is a more rapid sedimentation of the erythrocytes in tuberculosis, most rapid in the most active cases.

The general constitution is of less importance than would be supposed. Acute types often occur in robust individuals; great muscular strength in a patient demands a careful prognosis on account of the tendency to overexert. On the whole, a good constitution demands a more favorable prognosis than the opposite, although some large, well-nourished individuals seem "soft" and lack resistance, while wiry, thin individuals do remarkably well.

The *habitus phthisicus* is not always unfavorable but a paralytic or deformed thorax which limits respiration is unfavorable.

Physical Signs.—Physical signs tell what injury has occurred in the lungs, the constitutional symptoms what is occurring at present, and only by a careful consideration of both symptoms and signs can we hope to arrive at an approximately correct prognosis. Physical signs obtained rom a single examination yield little evidence in regard to activity or arrest. The signs of softening are notoriously uncertain. For these reasons physical signs are for prognosis of far less importance than symptoms. The physical signs indicate not the amount of poisoning, but the amount of local reaction of the tissues.

The *site* of the lesion is not unimportant. The disease is discovered earlier at the apex, and for this reason, if for no other, the prognosis is

usually more favorable. Primary infections of the base may be due to an overwhelming dose of infection and so are of grave significance. A lesion beginning in the middle lobe is always serious. There is no difference in gravity between the right and left side when the lesion is purely apical but an advancing lesion usually demands a worse prognosis when on the left, as there is only one fissure on the left and the upper lobe is larger.

Physical signs, unless consolidation be present, tell little of the extent of the lesion in the third dimension (depth). A large portion of the interior of the lung cannot be examined except by roentgen-rays, which in many instances yield information far more important for prognosis than physical signs. *Cæteris paribus*, the prognosis, more especially in regard to recovery, depends directly upon the extent of the lesion. As long as the disease is confined to one side the prognosis is better, but slight involvement of both apices is frequent in most favorable cases. As soon as the disease extends below the third rib the ultimate prognosis is definitely worse. Physical signs at an apex and base posteriorly may be produced by tuberculous and non-tuberculous disease respectively, and such cases are more favorable than those with even slighter physical signs which extend from apex to base, and are produced by tuberculosis. In a number of patients moderately coarse rales, rather superficial, can be detected after coughing over the whole of one or possibly both sides. These may be the only physical signs and the patient may be without symptoms. The prognosis in such cases is favorable for arrest as long as great care is exercised. Widely extended pleurisy runs a favorable course (Osler). Scattered foci, even though scarcely perceptible, are always of bad omen, but it is never safe to give an absolutely bad prognosis on physical signs alone. A limited lesion with disease of some duration is always favorable, while an extensive lesion of short duration demands a bad prognosis. Whenever severe symptoms occur with slight physical signs, the prognosis is grave. The mere fact that no definite line of march can be made out is often in itself of the greatest importance, as it may indicate that the disease will run a rapid course (Fowler).

A sharply defined cavity at one apex is more favorable for duration of life than an infiltration scattered over one to two lobes, but the majority of patients with arrest show only signs of infiltration. Excessive fibrosis in both lungs is unfavorable. The exudative type has always a worse prognosis than the proliferative. Leathery, creaking sounds replacing the mucous rales are often the first indication of subsidence of the acute process. Slight changes in percussion and breathing without rales are the most favorable physical signs. A complete and constant absence of all rales after coughing is very favorable, but those without change in the rales do better than those in whom they decrease (Trudeau).

The condition of the unaffected or less affected side must always be determined. Unilateral disease, with shrinking, is always more favorable if accompanied by compensatory hypertrophy of the opposite lung.

A patient will often become afebrile, have a lower or normal pulse, less cough and expectoration, gain weight, and in every way indicate that he is improving, and still the physical signs be found more pronounced

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or scattered over a wider area. The most probable explanation is that the disease was present in the whole area at the first examination, but the organism was not able to react to its stimulus. As the patient gained strength, the tissues "reacted" and the signs increased while the patient improved. The intensity of the lesion is less important than the extent. A sharp demarcation betokens a favorable course.

Sputum.—A gradual change from a purulent to a mucoid sputum is favorable. A sudden change from a purulent to a frothy, watery sputum is of bad omen and often indicates the onset of miliary or acute tuberculosis. When mucoid sputum becomes mucopurulent or purulent an acute process should be suspected, and if it contain elastic fibres and numerous tubercle bacilli where before there were few or none, a more or less extensive softening is present, and if coupled with other symptoms, a doubtful or bad prognosis should be given. A gradual decrease in the amount of sputum is favorable; a sudden decrease may indicate heart failure, a congestive process, or possibly acute miliary tuberculosis. The absence of sputum is not necessarily favorable. Large amounts of sputum daily for any length of time usually indicate extensive bronchial irritation and are unfavorable. A bronchorrhœa, however, may persist for months and the patient do well.

Tubercle Bacilli.—The occurrence of tubercle bacilli in the sputum always indicates ulceration and such patients have a less favorable prognosis. The longer tubercle bacilli occur in the sputum the less favorable usually the prognosis. Tubercle bacilli load the prognosis more than hemoptysis.

The unequal distribution and the possible variation in staining of the bacilli, the temporary occlusion of the focus, the fact that patients with rapidly advancing disease may give off few bacilli, and fully encapsulated cavities in arrested patients, enormous masses, all emphasize great caution in prognosis from the number of bacilli. An early disappearance and persistent absence of tubercle bacilli is most favorable.

Morphology affords little aid, but short bacilli are usually held to indicate an active growth of the infecting organism, and so an unfavorable prognosis. Long, slender, beaded, irregular bacilli indicate a chronic course, but not necessarily a favorable termination. The same is probably true of the bacillary fragments, "splitter."

Secondary infection is *a priori* unfavorable, but owing to the great difficulty in diagnosis cannot be relied upon for prognosis.

Elastic fibres are now seldom found in sanatorium patients and their constant presence is of very unfavorable import. Fibrinous coagula (fibrinous bronchitis) are of bad prognostic omen.

Complications.—Any complication is unfavorable, but all of a tuberculous nature bespeak lessened resistance and are of grave significance. Simple acute or even chronic *laryngitis* is of slight importance, but tuberculous laryngitis makes the prognosis at once grave. Slight ulceration of the cords without infiltration is the least unfavorable form. When complicated with dysphagia the condition is most serious. Simple acute *bronchitis*, especially if the attacks are frequent, clouds the prognosis. In advanced stages it may be the primary cause of death.

Dry *pleurisy* as a complication, even if extensive, is not unfavorable. The effect of a pleuritic effusion depends partly upon the size of the effusion, partly upon the stage of the disease. As an onset it is distinctly favorable; during the course it exerts little influence. Hemorrhagic effusion is always serious. Empyema is rarely recovered from but the improved methods of treatment will no doubt improve the prognosis. *Pneumothorax* is always serious but recovery may occur.

Non-tuberculous *enteritis* seems to be well borne, especially if of the neurotic type. Recovery from intestinal tuberculosis, diagnosed early and properly treated, is frequent.

Arthritis, rheumatic fever, mitral stenosis, cardiac hypertrophy, slight emphysema, bronchial asthma, and gout have all been held to exert a favorable influence on pulmonary tuberculosis. Typhoid fever is not necessarily unfavorable. Diabetes mellitus, still a serious complication, if properly treated is far less unfavorable than formerly. Pulmonary stenosis, pulmonary gangrene, lardaceous disease, tuberculous stomatitis or pharyngitis, severe thrush, meningitis, œdema, melancholia, insanity are always of very grave if not fatal significance. Mild diphtheria exerts but little influence when properly treated. Syphilis is said in the early stages to be unfavorable, but is well borne in many patients who ultimately recover. Bronchiectasis is unfavorable. Enlargement of the thyroid is not unfavorable unless accompanied by symptoms. Tuberculous otitis media and slightly enlarged lymph glands occur in patients whose disease runs often a chronic and possibly an unfavorable course. Persistent anemia is unfavorable. Fistula-in-ano exerts little influence and is not unfavorable in itself. Chronic peritonitis, even if pelvic, is unfavorable.

The duration of treatment is important. Little can be expected from a "cure" of less than three months, and the best results are those obtained after three or four years.

Prognosis is always uncertain. The anamnesis is of less value than the actual condition. Symptoms are of more value than physical signs, and are, in the order of their importance, those referable to the digestive tract (including weight), to the nervous system (including character), the pulse-rate, and the fever. Complications, especially if tuberculous, are always to be dreaded. The urine, the sputum, and the blood are of far less value in prognosis than the foregoing. Race, age, sex, heredity, mode of onset, the shape of the chest, spirometry, etc., are of only secondary importance, and, like the urine and sputum, helpful if they concur with the symptoms and physical signs, of little value if they contradict them. The financial condition and the environment of the patient should always be considered.

PROPHYLAXIS OF TUBERCULOSIS

Prophylaxis can be reduced to two fundamental factors—destruction of the specific germ and increase in the individual resistance. The chief source of tubercle bacilli is the sputum, dried and ground into dust

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or sprayed into the air in coughing. Hand to mouth infection, *i.e.*, contamination of hands with sputum deposited on the streets or in gutters by means of playthings (balls, tops, etc.) may readily occur (Krause). The tubercle bacillus is not ubiquitous, and is usually found only near the tuberculous patient. The individual resistance is probably what has enabled any individual of middle age to escape serious infection. The struggle to raise the resistance begins at birth and continues through life. The crusade must be against tuberculosis and not against the tuberculous patient.

State and Municipal.—Prophylactic measures will never be as immediately efficient as those against acute diseases such as the acute infectious diseases of childhood or smallpox. During the last two decades, special organizations, national, state, county and municipal, supported usually by private funds, have conducted such a propaganda of education, ably supported by the public press, that it may be said that no community in the United States has not been reached in one way or another. It appears that the best plan for community organization includes, according to Drolet (1) a study of the prevalence of tuberculosis in the district; (2) a list of the resources that can be used to control it; (3) notification of all cases to facilitate sanitary follow-up work (segregation, education, cleansing, and renovation); (4) the provision of ample dispensary facilities for early diagnosis and proper treatment at home (which all patients undergo sooner or later); (5) the provision of a requisite number of sanatorium and hospital beds; (6) suitable protection and strengthening of all those directly exposed to the disease; (7) the enlistment of all the public support possible; (8) the development and continuation of general public educational measures in regard to the diagnosis, treatment and prevention of tuberculosis. This summary must of course be changed to meet varying conditions, *e. g.*, in smaller and rural communities it may be necessary to hold clinics only three or four times a year when experts in diagnosis and roentgenography can be present. Or again, an expert consultation service, free to all patients suspected of having pulmonary tuberculosis, such as that conducted by Bartlett at Framingham, can be established. Free laboratory facilities are now widely offered, and most communities have antispitting ordinances. The time will no doubt come when not alone all public food handlers but also all domestics, especially nursemaids, will be periodically examined. In fact, all laws concerning the improvement of living and working conditions directly prevent tuberculosis.

The preventive work conducted at Framingham, Mass., by Armstrong under a grant from the Metropolitan Life Insurance Company to the National Tuberculosis Association, to bring into use all known prophylactic measures, has produced such suggestive results in the increased fall of the tuberculosis mortality over that in the adjoining communities, that the Milbank Memorial Fund has devoted a large sum of money to be expended along similar lines in New York State. They plan to add adequate rural nursing care and occupational therapy. Such work has opened the question how far the antituberculosis campaign, which has done more to stimulate public interest in public health work than any

other undertaking, should be conducted by private organizations. It would be ideal for the national, state and municipal health authorities to take over the entire work but, unfortunately, some feel that public health authorities in America, due to lack of stability, lack of properly trained personnel, and insufficient funds, will not be able to bring this about, however much desired, for several years.

Army and Navy.—Most recruits take their tuberculosis into the service with them. Careful examination will exclude most cases but it must be remembered that those from the country and small towns are more likely to develop tuberculosis than the city dweller.

Regulations Against Animal Tuberculosis.—Convincing proof has been adduced that the bovine tubercle bacillus can infect children; and even if infection with it occurs less frequently, it should nevertheless, be vigorously combated.

Dairies.—Model dairies have been started in many places. All cows should be tested with tuberculin and retested at intervals.

Milk from tuberculous cows with healthy udders has been found infectious. Such milk has been considered safe after boiling, but Smith pointed out that boiling even for ten minutes is sufficient only if no pellicle forms upon the surface, and Calmette and Breton have asserted that dead tubercle bacilli in such milk are injurious and affect healthy guinea-pigs like small, repeated doses of tuberculin. All milk from an uninspected dairy should be pasteurized, especially if used by children, invalids, or convalescents. Pasteurization has decreased the death rate in New York City from non-pulmonary tuberculosis by about 50 per cent. until today it is only one-third what it is elsewhere and W. H. Park finds only 16 per cent. of the cases of tuberculous adenitis due to the bovine bacillus, in contrast to 64 per cent. before.

Tuberculous cows should always be isolated, not housed; and it is wiser to use them only for breeding or working purposes, removing the calves at birth, as only $\frac{1}{3}$ of 1 per cent. are tuberculous at birth (Bang). Repeated injections of tuberculin may produce a tolerance, a fact made use of by unscrupulous dealers. Cattle which have been on a journey generally react but slightly for some time, due probably to the inhibiting effect of excitement on the heat centre (Bang).

The method of vaccination with living bacilli produces immunity for a limited period only. Immunized calves should be fed on milk from cows free from tuberculosis.

Slaughter-houses.—Tuberculous meat is of far less importance than tuberculous milk. About 40 per cent. of milch cows are said to be tuberculous and as these are usually slaughtered for "home" consumption, they are rarely, at least in America, properly inspected. For this reason public slaughter-houses where inspection can be properly carried out, are of great value.

Tuberculous fowls should be destroyed. Generalization of tuberculosis is much more rapid in the hog, which is frequently tuberculous, and greater care should be exercised in the use of its flesh.[1]

[1] See H. Sessions, Cattle Tuberculosis, for an excellent *résumé* of the whole subject of animal tuberculosis.

The danger from bread, from uncooked fruits and vegetables, unless handled by tuberculous patients, is so slight that it may be neglected.

Education.—Probably the most important and farthest-reaching prophylactic measure is education of the people in matters pertaining to hygiene. In the kindergartens and primary schools short lessons in general hygiene and the danger of spitting upon the floors should be given. In more advanced schools the lessons may deal with the prophylaxis of pulmonary tuberculosis. The danger of coughing without covering the mouth should be made clear. Children as well as adults should have the reasons for rules explained to them. It has been put in force in some countries, that a summary of the important elementary principles of hygiene be printed upon the covers of school-books. Excellent books for school-children have been published. The Modern Health Crusader movement and the excellent work of the American Child Health Organization have accomplished great things.

Education should not stop in the schools but be carried to the adults by illustrated lectures at halls convenient to the classes it is intended to reach. Every city should have its permanent tuberculosis exhibit where at frequent intervals demonstrations should be held.

Especial attention must be given to the education of those constantly exposed. It is not sufficient to give the tuberculous patient a few general rules, particularly if he is not very intelligent. Written or printed rules in detail should be left with the attendants, but they should be fully explained orally. In some cases it is wise to tack up a card where it can be seen by all the household and serve as a constant reminder. Those interested in this subject should communicate with the National Tuberculosis Association.

Notification.—This has been widely adopted. Good results have been obtained by voluntary notification, stimulated by a small fee for each case. The chief objection is the publicity which can be prevented by the passage of laws. The public should be informed that notification does not mean placarding the house or placing any restriction upon personal liberty as long as reasonable care is maintained. It should be made compulsory upon the patient, his family, and his physician to report to the sanitary officers a change of residence. The value of notification in relation to prevention, supervision, and education is difficult to overestimate.

The House.—"Consumption may well be termed a house disease." writes Flick. "Without the house it would not exist. It depends upon the house for its implantation, propagation and for evolution of all its phenomena. The house is the place where the tubercle bacillus lies dormant in wait for its new host; it is the place where the new host gets its implantation; it is the place where the tuberculous subject gradually becomes a consumptive; and it is the place where the consumptive dies."

Two important factors in regard to the house have long been known and insisted upon by sanitary experts, precautions against overcrowding and proper ventilation. A third important factor has only recently been introduced, thorough cleansing, renovation and possibly disinfection, which is far less important than the first two.

Overcrowding.—It has been clearly shown (for London) that the important feature in overcrowding is less the number of inhabitants per acre than the average number per room, and the mortality, further, is lower where each person occupies a single bed. At least 600 cubic feet of air space should be allowed for every adult and at least 400 for every child (Biggs). The tuberculosis death-rate is directly proportional in France to the size of the city (the larger the city the greater the overcrowding), but Graux thinks overcrowding of less importance in Paris than deficient ventilation and sunshine.

Ventilation.—Proper ventilation greatly facilitates the bactericidal action of sunlight. The height of the house should not exceed the width of the street. "Back-to-back" houses greatly increase the tuberculosis death-rate. Biggs held that houses on lots 25 x 100 feet should not occupy over 60 per cent. of the surface of the lot. Menusier found the death-rate more or less proportional to the number of stories. Lodging-houses should be provided with an automatic and adequate system of ventilation not under control of the lodgers. Partitions in lodging-houses, built upon the cell plan, should be raised 8 inches from the floor.

For dwelling rooms 3000 cubic feet of fresh air per head are needed every hour. Adequate provision should be made for parks in all cities. It has been aptly said that in the country the only bad air is in the farmer's houses, whence it seldom has an opportunity to escape.

Disinfection, properly performed, unquestionably destroys the unprotected tubercle bacilli but is considered by some far less important than proper cleansing. In rooms occupied by patients with explosive coughs and numerous tubercle bacilli in the sputum, which have been subjected to ordinary thorough cleaning, tubercle bacilli are difficult to find.

The most efficient method is as follows: For an ordinary room (1000 cubic feet) 1 pound (500 gm.) of lime, 8 fluidounces (250 cc.) of formalin, and 2.5 to 3 fluidounces (75 to 90 cc.) of commercial sulphuric acid are required. All openings but the door are sealed. The formalin is poured into an empty water pitcher, 4 ounces of water added, and the sulphuric acid poured slowly in. The lime is placed in a china or earthenware wash-basin on the floor upon newspapers, all water removed from the room, all drawers and cupboards opened, the mattresses stood on end, and the mixture poured quickly upon the lime and the door sealed. The sulphuric acid may be packed in a tin bucket containing the lime, and with the formalin in a separate bottle may be used by any person of ordinary intelligence. The room should remain closed at least six but better for twelve or eighteen hours. Dried masses of sputum should be soaked with a 2 per cent. solution of calcium hypochlorite and carefully removed. Paraform candles are effective for small spaces, such as closets.

In regard to other common disinfectants, much diversity of opinion exists. Phenol (5 per cent.), corrosive sublimate (0.1 per cent.), copper sulphate, and numerous others have proved in many instances unsatisfactory. It should never be lost sight of that after formalin or any disinfectant thorough cleansing is imperative. A room which has been

thoroughly cleansed is safer than a room in which formaldehyde has been used and cleaning neglected. Thoroughly wetting the ceilings, walls, floors, and furniture with 1 to 2 per cent. solution of chlorinated lime (1.5 ounces to a gallon), applied with a Turk's-head brush, gives excellent results. Where this cannot be done, rubbing the walls with bread-crumbs or dough may be of value.

After death or removal the entire place should be renovated. The model requirements in force in New York City include, besides disinfection, scrubbing the painted woodwork with a solution of hot soda, repainting, repapering, or recalcimining the walls. These methods are efficient in ridding an apartment of tuberculous infection which even with efficient disinfection is hard to accomplish.

Clothing.—Hangings, bedding, mattresses, pillows, and rugs should be disinfected with steam. All articles of little value and all old books and papers should be burned. All soiled linen should be boiled. Tubercle bacilli live the shortest time on white enamel paint.

Tenements.—The tenement house is a hot-bed for pulmonary tuberculosis. Model tenements have been erected in many cities and laws governing their construction passed. Buildings, hopelessly bad, should be condemned and pulled down.

Institutional.—In all institutions tuberculous individuals should be separated to some extent. Tuberculous patients should be admitted to a general hospital only if no special hospital exists. They should then occupy separate rooms and should not be allowed in the general wards. Hospitals for the insane should have separate pavilions for tuberculous inmates. Nurses and attendants in such pavilions would often do well to wear masks. Patients with pulmonary tuberculosis should be prohibited from living in common lodging-houses (Biggs).

Prisons.—Mortality from pulmonary tuberculosis has been so high in prisons and reformatories that sentence for a long term is almost equivalent to death by consumption (Johnston). Conditions in the county jails are often much worse than in penitentiaries. Each prisoner should be examined at once and if found tuberculous should not occupy a cell with a healthy person. After death or removal, the cell should be carefully disinfected. Ransome thinks whitewashing of little value and possibly of danger, through scaling and dust. Tuberculous should not be placed near healthy prisoners in workshops, should have lighter if any work, and the proper disposal of the sputum should be provided for. No tuberculous prisoner should be pardoned until his future environment has been carefully considered.

Schools.—School rooms should be well lighted, ventilated, and sunny. The floors and walls should be so constructed that they can be washed or cleaned by a vacuum cleaner. Hygienic drinking fountains with an upward flow should be placed in every school and the common drinking cup should be abolished. In doubtful cases the books should be disinfected. Slates should not be used. It would be wise to inspect all boarding schools and their staffs at intervals. Tuberculous teachers, scholars, and janitors should be excluded until their sputum has long been free from tubercle bacilli, and unquestionably it is better to exclude them per-

manently. Special classes in fresh-air rooms should be maintained for all tuberculous children.

Factories and Shops.—"The home and the workshop are the two places where environment of sufficient intensity for contamination and contact of long-enough duration for implantation can most readily exist" (Flick). The minimum air space per individual, proper temperature (60°–70° F.), ventilation and lighting, sufficient floor space, the substitution of mopping or washing for dry sweeping, absolute prohibition of spitting on the floor, a sufficient number of suitable cuspidors, proper medical inspection, limitation of hours, and regulation of hours for meals in a suitable place apart from the workshop, removal of gases, vapors, and dust, should be established in all workshops. Sleeping in workshops should be prohibited. Occupations entailing much exercise require more ventilation and less warmth than sedentary trades. It is advisable to paint all walls for about 6 feet from the floor with enamel paint.

Trades.—Some trades are especially dangerous and measures should be taken to protect the workmen. Appliances for removing dust in potteries, glass- and stone-cutting, polishing and grinding, hoods for noxious vapors, such arrangements of benches and machinery that the workmen will not have to sit or stand for hours in cramped positions, should all be provided. Certain trades should be scheduled as dangerous and be absolutely prohibited in sleeping rooms. Persons with tubercle bacilli in their sputum should not be allowed to handle or to prepare food for others, not should they attend non-tuberculous invalids. Dentists should always sterilize all instruments. Coal-mining, lime- and gypsum-working, and tanning have been looked upon as lessening the chances of disease. The trades unions would do well to strive vigorously for these reforms.

Traffic.—"Sleeping-car" infection may occur, but its importance has been exaggerated, although we should not for this reason relax our efforts for clean cars. Every coach that runs to a health resort should be disinfected with formaldehyde at the end of each trip. The construction should be as plain as possible. The vacuum system of cleaning has been successfully used. Dry sweeping *en route* should be prohibited. Brushing off passengers should be restricted to the rear end of the car or prohibited altogether.

Street railway cars, trams, and omnibuses would seem to be a source of danger. Flick states, however, that after some investigation he fails to find pulmonary tuberculosis more prevalent among conductors of these cars than among the general population. The majority of such conveyances are wretchedly ventilated and disinfection is rarely if ever carried out except for smallpox.

Hospitals.—Many competent observers hold that the great reduction and the low mortality in England are due to the establishment of hospitals for patients in far-advanced stages. These institutions are by far the most important in the antituberculosis crusade. Infection when happening usually occurs from those in the last stages.

Such hospitals should be founded by every municipality of 100,000 or more inhabitants. They should be situated in the healthy, wooded

suburbs, and easy of access. Further provisions for the open-air treatment should be made, for isolation without attempt at cure is deplorable and cruel. The grounds should be inviting and no opportunity spared to make the whole institution as attractive as possible. The average stay in such institutions may be said to be about six months.

When after notification the sanitary inspectors feel that proper precautions cannot be taken by the family in the case of a very ill patient, or that the patient insists upon breaking all prophylactic measures, if necessary he should be removed to the institution. It is safe to say that such a course will have a deterrent effect upon the most refractory patient and that actual forcible removal will seldom be necessary.

Dispensaries.—Next in regard to prophylactic value stand the tuberculosis dispensaries. The dispensary physicians should after careful consideration decide what is best for each patient. He should be visited at home and fully instructed in hygienic measures by the dispensary or visiting nurse who is probably the most important agent in the prevention of tuberculosis. Other members of the family should be examined. Printed directions for the patient of prophylactic measures should be fully explained and left for reference.

Sanatoriums.—The value of sanatoriums lies chiefly along two lines, education and arrest of patients in the "closed" stages. While 60 per cent. of the "open cases" still have tubercle bacilli in their sputum on discharge, the education they have received in the sanatorium renders them so careful that in most instances they are of little or no danger. Sea-side sanatoriums for children are most important, but day sanatoriums which receive advanced cases have a great value.

General Prophylaxis.—General prophylaxis dealing with sputum, its collection and destruction, coughing, rules for the tuberculous patient, and the cleaning of the house, strike at the fountain head of infection. If we could cut off the supply of infectious material from patients, infection would soon be reduced to the vanishing point.

Expectoration.—Careless expectoration is the chief source of infection. Laws should be passed in all cities prohibiting spitting upon the pavement, the floors or steps of public buildings, of elevated railway platforms, of waiting rooms, of all cars and steamboats, especially ferries, of wharves, public carriages, places of public entertainments, cafés, restaurants, shops, hotels, prisons, and boarding schools. These laws should be posted in all such places. It is not enough, however, to pass such laws—they must be enforced. No community has worse laws than it deserves and the enforcement of all laws is in the hands of the people. Not until public opinion is aroused and the public educated up to the fact that sputum is as nasty, as loathsome as, and in most cases more dangerous than, other dejecta (urine and feces) can antispitting laws be carried out. It is useless to try to prevent patients with tuberculosis from expectorating and allow the general public to do so.

Disposal of Sputum. All signs forbidding spitting should be accompanied by others, indicating where to spit. All persons should be advised to spit only when necessary and then to deposit the sputum, if at all

possible, in water. Patients should be told that it is for their own interest not to expectorate except into a proper receptacle.

Spittoons should be provided in all public buildings, places of assembly, cars, and along all stairways. They (1) should be of metal or unbreakable material (to avoid infection by scratching), (2) should, as far as possible, conceal the sputum, (3) must not allow their contents to spatter, must be placed breast high, (4) must be easy to clean and hard to upset. The ordinary slop-jar answers these requirements much better than the spittoons ordinarily employed. Spittoons should contain some antiseptic fluid, preferably one that digests or dissolves the sputum, although plain water will answer. Sand, bran, sawdust, or ashes should never be put into receptacles for sputum. The caustic alkalies in strong solution are very efficient.

Spittoons with constantly running water are excellent for the general public, but should not be used in sanatoriums or hospitals.

The advisability of doing away with spittoons in physicians' offices, dispensaries, and sanatoriums is fully recognized. It is not necessary for physicians, even in health resorts, to have spittoons in their offices. A few paper cuspidors, under a notice stating that every patient who expectorates should have a pocket cup, are far more cleanly, less disagreeable, just as practicable, and emphasize a most important measure. General sputum boxes or spittoons in sanatoriums lead to carelessness, are often the seat of accidents, and should be abolished. Everyone should be encouraged to use sputum boxes when suffering from pneumonia or other even slight respiratory diseases.

A perfect pocket sputum cup or flask has not yet been devised. Many patterns have been put on the market, but none are much better than Dettweiler's. The essential points of a good pocket cuspidor are that it should be easily managed, preferably with one hand; perfectly tight; not too bulky; easily cleaned, and so constructed that sputum does not adhere to the cover when opened.

The "cup" devised by Major D. W. Appell, U. S. A., consisting of thin, impervious card-board, so folded as to form an envelope which contains a bit of cotton, is very satisfactory for patients who expectorate but little or for use while walking. The main objections to it are the filaments of cotton that float off in the air each time the box is opened, the small capacity, and the tendency to spill unless always carried upright in the pocket. The "sanitary cuspidor," consisting of a metal (tinned-iron) frame, holding a waterproof-thick paper cup, so folded that flanges prevent spilling if accidentally overturned, is probably the best for use at home and in sanatoriums. The advantage of both these cups is that they need little handling and can be burned daily. The papers in the metal frames should be changed daily, the cup filled with sawdust and wrapped in paper and placed handy (in a special box) for collection by an orderly, who should wear rubber gloves. The metal frame should be washed in carbolic acid each day.

The use of cloths or paper napkins is not to be recommended, but is at times necessary for the very ill or very poor. Each cloth or napkin should be used but once and immediately deposited in a paper bag or

a newspaper folded into a bag pinned on the side of the bed. This helps to prevent drying, does away with a second handling, and facilitates burning.

If cloths or paper napkins are used, the hands should be frequently washed, for Baldwin has shown that unless the patient is scrupulously clean the hands are frequently soiled. The handkerchief should never be used for sputum nor employed to wipe the lips after expectorating, but a special cloth should be kept for this purpose.

Sputum may be disinfected by heat or by chemicals. The best method is by burning, which may be done in a special crematory or one connected with the general heating system. In the home the kitchen stove and a hot fire are all that is necessary. The boxes filled with sawdust, should be carefully placed upon the fire. Boiling when used should be continued thirty minutes. Disinfection with live steam is efficient and renders the sputum fluid. Destruction by chemical means is usually expensive and not always efficient.

The emptying of sputum cups into drains or water-closets should never be permitted in hospitals or sanatoriums. Putrefactive organisms have little effect upon the tubercle bacillus, which may live in drain water for one hundred and ninety-four days. Moeller's work has shown the danger of throwing sputum into sewage-disposal plants, especially when the water is afterward used for irrigation. He found tubercle bacilli on radishes. Tubercle bacilli, however, quickly disappeared from a river (in 5 miles, flow about 2 miles per hour) into which the sewage from a health resort emptied.

Coughing.—Patients should always hold a cloth (not the hand) before the mouth on coughing or sneezing. This cloth should be frequently changed and burnt and not used as a handkerchief.

Feces and occasionally urine, even when the alimentary and genito-urinary systems are apparently free from tuberculosis, may contain tubercle bacilli. For disinfection, chlorinated lime, carbolic acid, or burning should be employed.

Rules for Patients.—All patients should be instructed about personal cleanliness, and they should be fully alive to their duty to the public, for until this is realized little effective prophylaxis can be accomplished. Beards and moustaches should be worn short, if at all. Kissing should be forbidden. The hands should be frequently washed and the patient cautioned about touching any articles of food intended for others. Carelessness about the sputum should not be tolerated. The patient should have his own bed, 4 feet distant from another, and, if possible, his own room. It is unnecessary, when the patient comes to the table, to have special dishes if care be exercised in washing, but when confined to bed his tray and dishes may be kept apart and washed separately. The patient's room should be carefully cleaned, never swept, and 5 per cent. carbolic acid solution used when necessary. The room should be furnished with washable curtains; carpets should be removed and rugs provided. The blankets should have washable covers. The walls should be painted, preferably with enamel. The patient should have the sunniest, best-ventilated room in the house.

House.—Dampness is conducive to pulmonary tuberculosis, and the soil and subsoil, therefore, should have ample drainage. The cellar should be cemented. There should be no inside rooms and all rooms should have two windows. The window area should be at least one-seventh of the floor space. Too many trees should not be permitted close to the house. Dry sweeping should be abolished and all brooms covered with bags which have been moistened in some antiseptic solution. A vacuum cleaner should be used when possible. Both mops and cloths should be boiled or soaked in some disinfectant.

Laundry.—The infection of workers in laundries can be prevented. In all hospitals and sanatoriums the personal and bed linen should be handled as little as possible. It should be placed in bags, and, on reaching the receiving room of the laundry, put in the sterilizer, which should be the only communication between the receiving and assorting rooms. All bankets, pillows, and mattresses should be disinfected with live steam and formalin. Blankets can then be washed. Especial care should be taken of handkerchiefs, which should be gathered in bags and disinfected. A wire basket, attached to the head of the bed, to hold cloth and cup prevents soiling of the sheets and bed linen.

Servants.—The danger of infection from tuberculous house servants is not sufficiently appreciated. Their close confinement, small, poorly lighted, and wretchedly ventilated rooms often act like a boomerang.

Domestic Pets.—Fondling or kissing parrots, dogs, cats, or canaries may in rare instances transmit tuberculosis, but the danger is slight.

Churches.—It is a natural instinct, that, as man realizes that human aid is of no avail, he should turn to the church. The use of individual communion cups, which should be carefully cleansed after use, is growing rapidly and should be encouraged.

Individual Prophylaxis.—The very nature of the disease, its simulation of catarrhal bronchitis and other benign diseases, will always make individual prophylaxis of much importance. To two classes it is of especial value, to the very young and to the predisposed.

Prophylaxis should begin at birth, especially if the child comes of parents weakened through any disease. If the mother be the subject of tuberculosis she should not nurse the child, and its contact with her should be as limited as possible. In no case should the child occupy the same bed or room. The milk should be "certified" or pasteurized. The nursery should be the sanctum of every household and visitors should not be allowed to enter it. The children should be brought down to the visitors, and should be taught not to kiss strangers and to keep everything out of their mouths. It is a wise plan to taboo street shoes from the nursery. At first the child may be confined to a clean blanket placed upon the floor, but this is not possible later. The bacterial flora of the floor is soon to be found on his hands and under his nails. The floor, therefore, should be scrupulously clean and with as few cracks as possible. A heated tile floor with tiled walls makes an ideal nursery. A broom should never enter this room, which should be bright, sunny, and well ventilated. Children should never be allowed in a consumptive's room unless it be for only a moment. Such ideal conditions may be attained in the homes

of the educated and well to do but among the less fortunate they are impossible. Here the home containing children, especially infants, should harbor no open tuberculous patients whether parent, relative or servant. Infancy is the period of greatest susceptibility, and contact with infection, harmless to the adult or even to the older child, may infect the infant who is more likely to develop acute fatal disease. Hence strenuous efforts should be made to protect children under three years.

From the second to the fifth year the child should be gradually accustomed to cool and then cold sponges, given while standing in warm water. The house temperature should be 65° to 68° F. and the air not too dry. The nursery should be flushed several times a day with fresh air and a window should be constantly open at the top, day and night. For the predisposed hyperventilation is necessary. If is often well to have a second room, which the children can use for a few hours every day, and it is always preferable that the attendant sleep in an adjoining room. The hours out-of-doors, especially for predisposed children, should be gradually lengthened in winter and nearly as continuous as in summer. At an early age these children should be taught self-restraint and unselfish habits. The chances of escape or recovery from pulmonary tuberculosis are often lessened by neglect of this rule. The ideal place for such children is the country or an open suburb. If not strong when the school age arrives, he should be placed in the fresh-air room and subjected to frequent inspections, occasional medical and dental examinations.

In fact all children should be periodically examined, all defects remedied, and those undernourished studied to see if their food is proper in quantity and quality. An esprit-de-corps should be developed to see that the percentage of underdeveloped is reduced to a minimum. The health chores of the Modern Health Crusaders are a great help along these lines. The work of the National Child Health Organization has also been most valuable. Emerson's "nutrition classes" have been extremely helpful.

Even with such precautions it is questionable whether tuberculous infection is reduced, *i. e.*, whether any fewer children will react to the tuberculin skin test, but tuberculous disease, due to repeated and massive infection will be, and has been, prevented. All children who have been exposed should be protected as much as possible against all infectious disease, especially measles and pertussis. Grave responsibility rests upon school authorities. The time may yet come when, recognizing the harmlessness of the tuberculin skin test, all children will be subjected to it and those who react watched more carefully for several years.

The employment of tuberculous midwives, the practice of ritual circumcision by a tuberculous rabbi, tasting the child's food, chewing it before feeding, or blowing upon it, are to be condemned strongly.

As the child grows older he should be taught to hold himself properly and outdoor sports of all kinds should be encouraged, but care taken to regulate them to his strength. Especial care must be taken of bad eaters, for these are very susceptible (Brehmer). Any individual, especially when young, who is 10 pounds or more under weight, should take precautionary measures in regard to pulmonary tuberculosis.

The period of adolescence is of considerable importance in that this period of considerable bodily development is often accompanied by increased study or social activities. For others, it means entrance into work with its added strain and worry or assumption of home duties. Some believe that the immunization, due possibly to the implantation of the bovine tubercle bacillus, now disappears. However, this may be, the dangers of this period are real, and especially so for the predisposed. The modern tendency to overindulgence in amusements increases the danger for many for to hard work they add fatigue and loss of sleep, factors which may change the tuberculous infection into tuberculous disease, for by this age a large percentage (some say 80 to 90) are infected.

Change of climate, a sojourn at the seashore or in the mountains is of great assistance to many youths and girls, especially about the age of puberty. Long sea voyages and ranching are also good. These are especially valuable just about the age at which other members of the family have developed the disease.

Choice of a Profession.—The choice of a profession for predisposed individuals is a difficult task. They should if possible choose an outdoor occupation which does not entail too much exposure to inclement weather. A change from an outdoor to an indoor calling often results disastrously, and Burgeois called attention to the danger of the city for rural inhabitants.

For girls the problem is more difficult. The majority of outdoor professions entail roughness and lack of suitable companionship.

Amusements.—Many places of amusement are poorly ventilated, overheated, and improperly cleaned. Predisposed individuals should not frequent them too often. Their amusements should lead them into the open air. Games of all sorts should be cultivated. Alcoholic and sexual excesses are especially dangerous.

Marriage.—Marriage for persons with tuberculous forebears need not concern us if the individuals are robust. If the contrary be the case they should be cautioned about excesses, and the woman if weakly should be warned of the danger of frequent pregnancies.

In regard to marriage of the tuberculous, it is certainly wiser to postpone it until the tuberculous individual has been well for two years. For the well-to-do, who have no worry about money matters, marriage should be more readily sanctioned than in the poor, in whom anxiety for the wife and babies may harm the tuberculous husband or the care of home and children be too much for the tuberculous wife. Under the latter condition it is wiser to avoid conception.

The danger of infection of healthy individuals who have married tuberculous patients has been much discussed. This danger, though not great, is undoubtedly real. Kissing should not be practised. The danger of infection by coitus is very slight. Tuberculosis is so rarely transmitted before birth that such danger can be neglected.

Results.—All forms of tuberculosis are rapidly decreasing in nearly every civilized country. In the United States the tuberculosis death-rate fell over 50 per cent. in twenty-one years and is still falling. In England and Wales the fall from 1851 to 1921 was 51 per cent. in males

and 65 per cent. in females. This means that 100,000 fewer persons die annually in the United States now than would have died had the former rate been maintained. The cause is not easy to determine. The fall antedates the development of the anti-tuberculosis campaign, and has been attributed by some, without convincing proof, to some change in the genetic or constitutional factors. Others affirm that it is due entirely to factors within human control; lessened opportunity for massive infection and improvement in the general well-being of the population. In this country the antituberculosis propaganda undoubtedly started the marked decrease, and improved living conditions have accelerated it. Rates of 37, 39.9 and 43.3 per 100,000 have occurred in Nebraska, Utah, and Kansas. The rates fall uniformly as one passes from lower to higher levels of economic well-being, except among children, where lower rates exist among the industrial population than among the general public. The fall has favored males more than females, and especially those from twenty to forty-five years of age, whites more than colored, and infants under one year, where a fall of 53 per cent. was greater than in all ages (40 per cent.). Most deaths now occur at forty-seven instead of at thirty-seven and a half as in 1911. Dublin, from whose excellent study many of these facts were drawn, is convinced that sanatorium care has prevented at least 6000 deaths a year and possibly many more, when the number of patients treated in open health resorts is considered. If more early cases were admitted to these institutions 22 per cent. instead of 10 per cent. more lives would be saved. The death-rate in 1930 will probably be 50 per 100,000 in the United States. The tuberculosis family relief-rate fell 32 per cent., while the death-rate fell 46 per cent., and the population increased 6 per cent in New York City. In fine, nearly 16,876 families were spared having one or more of their members die of tuberculosis. One-third of all the relief work in New York is caused by tuberculosis, and is especially due to the death of the father. The number of dependent children has greatly decreased due possibly, among other things, to the fact that few mothers die while the children are young (H. Emerson). Studies of certain racial groups are needed.

In *education* lies the greatest hope of the future, education of the patient, of the public, and especially of the legislator. This can best be brought about by voluntary organizations which can stimulate the creation of new health activities, and study, criticize, and support them; can make demonstrations, further publicity, and urge that within limits public health can be purchased, and bring about increased appropriation for this purpose. Public health work in America has received its greatest stimulation from the antituberculosis campaign.

TREATMENT OF TUBERCULOSIS

There is probably no chronic organic disease which shows greater tendency to repair and recovery, but this very tendency is fatal for many patients. There is no disease that yields so quickly to such slight efforts on the part of the physician and no disease which progresses so steadily to recovery in the face of so much injurious treatment.

However, these favorable results do not always obtain and the enthusiasm of both patient and physician is often severely tried. The time allotted to the treatment is almost invariably too short, and many patients lack enough persistence to regain their lost health. Another most important factor, really a serious danger, is that many patients in a few weeks enjoy a feeling of almost perfect health. If a patient felt ill and weak until a full recovery were effected, the percentage of recoveries would be many times increased.

There is no specific for pulmonary tuberculosis. The hygienic-dietetic treatment is almost "specific" for the general condition which, with such treatment, soon equals or surpasses any state ever reached in health. With the lungs it is a different and a vastly more difficult problem. To change, to arrest permanently, a pulmonary lesion requires not months, but years. The first part of the time should be passed under careful medical supervision; the latter may be devoted in part to work.

The success of a physician in treating pulmonary tuberculosis depends largely upon his ability to deal skilfully and individually with the physical, psychological, and sociological problems that arise with each patient. His former habits and idosyncrasies must be carefully noted and all retarding physical defects (teeth, tonsils, nose, sinuses, etc.), should be remedied as soon as advisable. He should be told at once that he has pulmonary tuberculosis, for the shock is soon over. The details of the treatment must be gone into fully and the importance of implicit obedience impressed. He should be told that in conscientious observance of minutiæ lies health, and the reason for every rule should be made clear. The duration of treatment is difficult to estimate and varies much with the object in view, *i. e.*, whether improvement, or arrest, be aimed at. Three months is the shortest period from which any permanent benefit can be derived, and this only in the earliest stages. As the disease advances much longer periods are necessary, and two or three years may be required.

The *clothing* must not be too heavy. Sensible perspiration and chilliness are equally dangerous. Wraps should always be at hand. Linen or woollen underwear is to be preferred, and chest protectors and chamois waistcoats should be strictly forbidden. Water-proof clothing should be avoided during warm weather, but the feet must be kept dry or dried at once on return from exercise. Damp clothing should always be replaced at once by dry. Hats may or may not be worn, but the head must be protected from the hot sun. Corsets should never be worn tight, and for some patients Ferris waists or girdles are much to be preferred. The same garment should never be worn for more than twelve hours (*i. e.*, night and day) without thorough airing.

Patients subjected to life out-of-doors and to hydrotherapy soon acquire resistance to colds and to other slight infections.

The details of the daily life for a patient may be stated simply as follows: 7.00, awake; milk (hot if desired) if necessary; wash with hot water, followed by a cold sponge, at least to the waist; 8.00, breakfast; 8.30, out-of-doors and at rest; 10.30, lunch when ordered; 11.00, exercise when ordered; 1.00, dinner; indoors not over one hour, less if possible;

2.00 to 4.00, absolute rest—no talking; sleep if possible; 3.30, lunch when ordered; 4.00, exercise when ordered; 6.00, supper; 7.00, outside on good nights; 9.00, lunch and bed. Once or twice a week a hot bath, followed by a cold sponge.

Hygienic-dietetic Treatment.—This has been called "sanatorium treatment," as it was first carried out in these institutions. Briefly, it may be said to consist of good nourishing food in proper amounts, fresh air by day and night, rest and exercise properly regulated for each patient, and education about what he should do.

Fresh air is a most important factor, but this estimate of its importance rests upon empirical grounds. Fresh air stimulates the hematopoietic functions, the nervous and digestive system, as well as many other organic functions. Its action depends upon its temperature, moisture and movement.

The number of hours spent *out-of-doors* varies for the individual, the climate, and the season. In summer, individual peculiarities are of less moment and nearly every patient can spend day and night out-of-doors. In winter, especially in cold climates, many patients find it impracticable to spend more than eight hours out-of-doors. Senseless exposure must be avoided. Unquestionably many patients have been overdosed with fresh air. The object sought is stimulation, not overstimulation or exhaustion, as occurs in some weakened patients.

The hours out-of-doors should be spent on a comfortable reclining chair or bed on a veranda, never deeper than its height, facing southerly in winter, northerly in summer, well protected from wind, but freely open to the air and well lighted artificially for use after dark. Many observers feel that it is wiser in all acute cases, and for many nervous patients, to employ separate balconies or at least divided porches where each patient can be alone at perfect rest.

Many patients living in cities are unable to have access to a balcony, a back yard, or even a roof. Many such make good recoveries in well ventilated rooms. A well constructed tent is often most helpful.

Sleeping out at night makes little appreciable difference in the immediate results. For patients who must work indoors it is invaluable. The night air of cities is the purest. Patients who are ill and who may require the services of a nurse (night-sweats, hemoptysis, etc.) should sleep out only under exceptional circumstances. The "lean-to," devised by King, is so constructed that the patients sleep and live out-of-doors on deep, covered porches, extending out on both sides from central living- and dressing-rooms. Bathing and heating facilities, and a small room, where a patient taken suddenly ill can be moved, are essential to this structure.[1]

Rest and Exercise.—The proper regulation of these is most difficult. It is always wise to err at first on the side of rest, but patients must never return to their former occupations with their muscles so soft and flabby, that relapse is indelibly written upon them.

The *rest* at first, particularly in febrile patients, and in those in whom the disease has just become manifest, should be absolute (in bed on a

[1] See Jacobs, P. P.: Sitting and Sleeping in the Open Air.

porch). Six weeks of rest in bed is highly advisable for all patients beginning treatment irrespective of symptoms or extent of disease. Indeed it is vastly more important in the early cases as recovery is hastened and assured by such a method. During this period the education of the patient can be carried to such a point that many foolish and ignorant mistakes are avoided and chances of recovery consequently greatly improved. All business cares, letter-writing, study, prolonged or exciting conversations, should be forbidden. For a time the patient should see few visitors. Overexercise en route to or on arrival at a health resort is frequent, and physicians sending patients away from home should carefully guard against it.

The rest treatment should consist of six weeks in bed, and if all goes well it should be followed by very carefully regulated exercise. If, on the other hand, signs of activity persist and the disease advances in spite of attempts to produce localized pulmonary rest, other measures must be considered. The first is to put the patient at "typhoid rest" allowing him neither to talk nor to feed himself. If the disease is apical the patient may be urged to lie on the affected side, beginning with a few minutes and increasing the time until he uses it continuously. At the end of two or three months or sooner, if he wearies of such treatment and the disease continues to advance, artificial pneumothorax should be tried. If this cannot be performed extrapleural thoracoplasty may be debated. These are the most extreme measures of rest at our command.

At the end of some months exercise should be begun in suitable cases and therefore the problem resolves itself into getting the patient into "condition." Passive exercise by massage may be begun when the patient is still in bed, before the temperature is fully normal and when the loss of weight is still marked. It should be carefully watched and cause no fatigue. Active exercise should be begun as soon as advisable for exercise is as important as rest but vastly more dangerous, being in most instances the direct cause of relapse. It is wise to furnish every patient with a few simple printed rules for exercise, such as the following: (Exercise means walking. Special permission must be obtained before indulging in other forms of exercise). None if feverish. None if blood in sputum. None if loss of weight. None if fast pulse. Never get out of breath. Never get tired. Never run. Never lift heavy weights. No mountain-climbing. Go slow. Exercise regularly and systematically, whether rain or shine. Walk up hill at start so as to come down hill on return. Remember always that you will have to return. Rest two hours after the midday meal. The best time for exercise is at 11 A.M. and 4 P.M. For patients with a weak digestion, rest for one-half hour before and after meals is often of great value.

Exercise should always be taken out-of-doors, and the best form to begin with is walking on the level either alone or with two or three companions at a rate of 2 miles an hour, with frequent pauses for rest. It is wise to begin with five minutes in the morning and gradually increase in suitable cases a few minutes each week, until the patient is able to spend two to four hours each day on his feet without fatigue. Inclines or a flight of stairs should not be attempted until the patient can walk

one-quarter to one-half hour on the level. In some instances riding for a definite short time, or a short boat ride, may be allowed when the patient is able to walk but a few minutes. All violent sports should be avoided. Golf (without the full swing), croquet, fishing and hunting (not entailing too much exercise), gentle bicycle riding (on the level), gentle rowing or paddling, skating (for those proficient), snow-shoeing, swimming (in great moderation), and horseback-riding may be indulged in with moderation, when the disease has been arrested for some months. It cannot be denied that many patients who indulge in violent exercises after recovery remain well, but more relapses occur from overexertion in sport or games than from work. The amount of exercise that any patient can finally do depends upon his former habits.

There are four chief *contraindications* to active exercise: (1) Fever, (2) rapid pulse, (3) blood in the sputum, and (4) loss of weight. While these symptoms cover nearly every case, in a few patients great dyspnœa on the slightest exertion, severe cough, marked weakness, gastric disturbance, increased cough and expectoration, and increase of physical signs, are also contraindications to exercise. A subnormal temperature (oral) in winter is of little moment in regard to exercise, when the general condition is satisfactory. A rise of temperature (rectal) to 101°, which after one-half hour of rest falls to 99.5° F. or lower, does not contraindicate exercise. The effect of overexertion is often a lowering of the oral temperature of the same day, while the rise does not manifest itself until the second or even the third day. The pulse should be taken before arising and at rest. When at any time it reaches or exceeds 100 per minute, exercise should be taken with great caution and the pulse frequently noted. A pulse of 110 or over at any time of the day while at rest is a contraindication to any exercise, even dressing. These statements, however, do not refer to a patient who is just convalescing from an acute attack, when some cardiac weakness is expected.

Treatment by "*auto-inoculation*" consists in absolute rest in bed (not permitted up for any purpose and even fed) until the temperature is normal. The patient is then put upon walking exercise until he can walk 6 to 10 miles a day without rise of temperature or increase of any symptoms, when he begins work and passes gradually from carrying light baskets, through carrying large baskets, sweeping, chopping, hoeing, painting, digging, and using a wheelbarrow, to do really heavy outdoor work. The results *when carefully controlled at every step* are excellent (see Paterson: Auto-inoculation in Pulmonary Tuberculosis) but otherwise dangerous. Few use this method.

Respiratory Exercises.—On the one side all unnecessary movement of the lungs is forbidden, and artificial pneumothorax, weights on the affected side, lying on the affected side (postural rest), belts encircling the chest, a plaster corset or adhesive strapping advocated with sound logic. On the other, some foolishly recommend active pulmonary gymnastics in subacute stages.

The simplest form of *respiratory exercise* is sighing. Walking up gradual inclines accomplishes the same end. Singing also requires deep breathing and to some may prove injurious. Only those patients with

normal temperature and pulse, with minimal or moderately advanced, localized, or slightly disseminated, inactive pulmonary lesions, should do pulmonary exercises. Active or multiple cavities, old or advanced fibrosis, severe laryngeal involvement and hemoptysis, as well as dyspnœa and palpitation after the exercises, are contraindications.

Dietetic.—The main object of dietetic treatment is to enable the patient to regain his lost weight, but not to make him a "flabby, breathless mass of inert fat." A patient who eats and digests well is a patient half-cured. The teeth should receive careful attention and be placed in order at once.

The preparation and serving of meals should receive the strictest attention, as the kitchen is the only pharmacy that many patients should know. The meals should be carefully chosen and each planned in relation to the preceding. The physician should scrutinize the diet and lay down broad general rules. It is wise to vary the diet as much as possible and special dishes on special days of the week should be avoided when possible. The table should attractively arranged and the food well and quickly served (not quickly eaten). Many patients eat well if the courses follow one another rapidly but if long delays occur, cough or fatigue may prevent the eating of the desired amount. To pile up a plate with large amounts and to expect a patient, who has little or no desire for food, to consume it is a mistake. Repeated helpings until the desired amount is eaten are preferable.

In acute and subfebrile cases the meals should be served in the bedroom or on the veranda, and when possible a nurse or attendant should be present to supply any wish of the patient and to encourage, coax, or even command him to further effort. As convalescence is established the patient should be allowed to come to the table for one meal a day, usually the midday meal. Congenial table companions are almost a necessity to obtain the best results.

The following dietary is one frequently followed, and gives on the whole excellent results: A glass of hot milk or a glass containing equal parts of coffee and hot milk may be given before rising if the cough is severe and distressing. Breakfast, served at 8 A.M., should consist of fruit, cereal and cream or butter, eggs, steak, chops, or a little broiled bacon, bread and considerable butter, 1 or 2 glasses of milk, and a cup of tea or coffee. If deemed advisable a glass of milk or a raw egg should be taken at 10 A.M. Dinner at 1 P.M. should consist of soup, or tasty bouillon or broth, fish or oysters, rare roast beef, mutton, turkey, chicken, and occasionally for a change, if desired, ham, pork, duck, or a little goose; fresh vegetables in abundance and variety; salads with an oil dressing, puddings, jellies, or ice-cream, simple cake. One glass of milk may be taken at the end of the meal and bread and butter in abundance. A demi-tasse of coffee is permissible. All sauces should be prepared with good butter. When prescribed a glass of milk or an egg may be taken at 3.30 P.M. Supper at 6 to 7 P.M. should include cold roast beef, mutton, chicken, occasionally ham, or eggs; a hot meat with vegetables is often very agreeable; bread, butter, tea, cocoa, milk (1 or 2 glasses), jam or fruit (fresh or preserved). A glass of milk at bedtime and

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another during the night if awake may be given in some cases. Lunches often may be profitably omitted one day in seven, usually Sunday or indeed entirely if the gain in weight is satisfactory.

The amount necessary for any individual is difficult to determine. Every patient should be told that he must eat to recover. He may not experience real hunger, but an eating appetite, an appetite that increases as one begins to eat, one which enables him routinely to eat all that he should, is to be most highly prized. When first under treatment the appetite furnishes no index to the state of the stomach or the powers of absorption. All forced feeding may be controlled by examination of the stools for undigested food. Patients who have reached their highest known weight, if it corresponds to the normal weight for age and height, those with chronic fibroid pulmonitis and impeded circulation, those with enfeebled hearts, those with acute processes and very high fever, those whose failure of appetite and digestion is in excess of that caused by the general constitutional weakness, should not necessarily enlarge their diet. Many patients chronically overeat, and in a few overeating becomes a fixed idea. Too much is as bad as too little food. In general it may be stated that a patient should consume as little food as is necessary to enable him to gain on an average 1 to 2 pounds per week until his normal weight is attained. When the true normal weight is reached the diet should be slowly reduced and the lunches and milk gradually abandoned, if the increase of weight coincides with an arrest of the lesion.

Patients with slight fever can usually digest easily all good, plain, wholesome, solid food. Those with high fever may have some difficulty and should receive at first a fluid or semifluid diet and solids be added one by one. It is often wise to reduce the proteins and carbohydrates during an acute exacerbation of fever. In a few patients the careful use of antipyretics may increase the gastric secretions (Hildebrand) and often enables the patient to eat a good meal. The principal meal of the day should be taken, when possible, during the afebrile period.

Milk, eggs, and meat are the most important foods. It is difficult to overestimate the value of *milk*, which often enables a patient to regain quickly his lost weight. The amount required varies, but 3 pints for patients on a general diet is a safe limit. Some patients with a strong antipathy to milk, by urging and after a fair trial, often overcome it. Small quantities should be used at first in such cases. When hot or cold milk is not well borne it may be treated in various ways. A pinch of table salt or sodium citrate may render the milk clot less firm and more digestible. One or more tablespoonfuls of lime-water, the addition of an aërated water, of a little coffee, tea, or even cognac may enable a patient to take a sufficient quantity. When these fail the milk should be peptonized and taken hot or cold. Koumiss, kefir, or "artificial" buttermilk (prepared with *Bacillus acidophilus* or *bulgaricus*), may be tried in case of intestinal fermentation. Whey and buttermilk are much less valuable. When milk cannot be taken, the amount of butter and cream may be increased or olive oil added to the diet. A little cheese is of value.

Eggs should be strictly fresh; for most patients 6 is a safe limit. They can be taken raw, as most prefer, or cooked. In some patients the yolk of the egg causes gastric distress or even purging; these should take only the white.

Meat is of importance and should at first be eaten at two meals. Beef and mutton are to be preferred. Twice-cooked meat should be avoided. Rare meat is better than well-done, and raw meat is held by some as the best, combining the maximum of useful results with the minimum of digestive effort. Raw meat (beef) may be given as scraped-beef sandwiches or in little balls, rolled in chocolate, when the taste is disagreeable, as it needs no mastication. The muscle plasma, ordinarily called beef juice, is of considerable value. The meat should be as fresh as possible, and often the cheapest and toughest cuts (brisket, rump, etc.) yield the most juice. Many of the meat powders are unpalatable. Meat extracts, bouillon, and meat broth, though containing little nourishment, often stimulate a flagging appetite.

Fats are of great importance to the tuberculous. The best form in which to administer fat is undoubtedly milk and its derivatives, butter and cream. Cod-liver oil, when combined with malt, aromatic oils, or bitter tinctures is more palatable. It should never be given during warm weather or when high pyrexia is present. There is no objection to a good emulsion whose formula is known. It aids in the metabolism of calcium and phosphorus. Sodium morrhuate has been given subcutaneously and intravenously as a "cure" but is still in an experimental stage. Olive oil, well taken by some patients, is valuable. Many fishes contain much oil, *e. g.*, sardines and salmon. The stools should be examined whenever fats are administered, to prevent excess of administration.

Water should be taken freely (1 to 2 quarts daily) between, and some preferably hot and one hour before meals. Coffee, tea, and cocoa may stimulate the organs to take up more nourishment.

Many prepared foods have been used with apparent success. Animal food rich in nitrogen is poor in phosphorus and vegetables supply this deficit. Fruits and nuts are of value.

Education.—To insure permanent results education of the patient in regard, not to the disease, not to the extent or character of physical signs, not to the changes in roentgen-ray plates, but to what he should do to get well, to stay so, to prevent relapse, to recognize relapse early, cannot be overemphasized. He should be told that the physical signs are comparable to the green lights, and the symptoms to the red lights on a railroad. The former mean go carefully, the latter, lay off on a side-track. During the preliminary six weeks rest in bed, much can be done in such education. A few good books should be placed in his hands but those dealing with or discussing symptoms should be avoided. "Rules for Recovery from Pulmonary Tuberculosis," by the writer, has been written along these lines in non-medical terms.

Institutional Treatment.—To institutional treatment the proof that pulmonary tuberculosis is curable is largely due. For many years the sanatorium was looked upon as the central point in the struggle against tuberculosis, but more recently it is evident that only a small fraction

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(possibly not over one-tenth) of tuberculous patients could gain admission or leave home to undergo treatment at these institutions.

Hospitals.—The tuberculosis hospital for advanced cases is of great value in the treatment of many patients too ill, certainly at first, to go to a sanatorium.

Dispensaries.—The dispensary affords the best treatment for those patients (almost 80 per cent.) who must remain at home and at times at work. It should coöperate with all existing charities, and should be open at a time convenient for working patients. The trained nurse is indispensable. She visits the home of every new patient, makes a careful report of the social condition, and revisits old patients to see that the instructions are properly carried out. Those interested should consult Miss Crowell's "The Tuberculosis Dispensary."

Sanatoriums.—The objects are twofold, healing and educational. The sanatorium should aim to arrest every patient, and, if possible, to do so in a period of residence of six to twelve months. However, many cannot be brought to arrest, but for these patients the educational influence is of great value and many ultimately recover by means of the knowledge so acquired. On leaving the sanatorium they teach how to prevent infection and still foolish alarms.

Selection of Patients.—This is most difficult in some instances and depends mainly upon the prognosis. Patients under fifteen years of age should be in special institutions with educational advantages, and those much beyond fifty rarely fully recover. In general all patients with minimal disease, and many in moderately advanced stages, are suitable for sanatorium treatment. Far-advanced or hopeless cases should not be admitted. Patients with advanced tuberculous complications, or with albuminuria, a persistent diazo reaction, melancholia, profound neurasthenia or in the later months of pregnancy, are usually not acceptable. Patients with slight tuberculous complications, such as slight thickening in the posterior interarytenoid space, slight superficial ulceration of one cord without infiltration, or fistula-in-ano, often do well. Former patients who have relapsed slightly often do well. Patients with pronounced symptoms out of proportion to the physical signs, with marked, persistent tachycardia or pyrexia (at home and at rest), those who have steadily declined since onset, with continuous loss of weight and those with marked dyspnœa on slight exertion are not suitable. Many institutions now demand a roentgen-ray examination before admission. The aims of the institution, however, determine the class of patients it receives.

Treatment.—The treatment of patients must be individualized and "hospitalization" avoided. Firmness, not dogmatism, should be aimed at with all rules, as well as great common sense. The patients act in many instances like children, and the responsibility upon the shoulders of a true sanatorium physician is not light. The following paragraphs refer mainly to afebrile patients, able to be up and about, but it must be borne in mind that in many institutions at least 25 per cent. of the patients are confined to bed.

The Daily Life.—On admission the patient should spend at least one week in the infirmary or reception cottage, where he is under close and constant observation and is taught many things that usually require months to learn at home. It is a grave mistake to watch so long over the patient that he feels he need no longer consider whether for him an act is "right or wrong." Strict rules are necessary, but should be as few and simple as possible. Smoking at stated intervals for selected patients may be allowed, but only out-of-doors, and inhaling should be forbidden. All patients should be in bed with lights out at from 9 to 10 P.M. Visitors should not be allowed to interfere with the routine, but at some time during each patient's stay at the sanatorium some member of his family should visit him to see what he should do on returning home. Visitors with colds or influenza should not be admitted.

Amusements, Classes, Work.—In all sanatoriums the time passes slowly for many patients and every opportunity to encourage idleness is afforded. This tendency should be strongly combated by suitable work, classes, or amusements. A good library and a piano for those patients who are allowed to play are important. Photography and sketching are useful, but Nature study is far more valuable than any of these. To arouse or instil a love of birds, flowers, geology, or some kindred subject, an interest which the patient can carry with him through life is of extreme value. Every patient if possible should leave the sanatorium with an outdoor hobby. For many Nature study has no charms, and for these arts and crafts of wide variety should be provided (occupational therapy). Suitable useful work is a great mental relief to many patients.

Work at a sanatorium depends much upon the class of patients. Many charitable or semicharitable sanatoriums require all patients to do some work, which, however, should be done leisurely and never under tension. Patients at work need very careful medical supervision, and malingerers often have to be overlooked for fear of injuring an honest patient. Ample time for rest should be afforded.

Length of Stay.—This varies from an average of three months to one to three years. No permanent benefit to the lungs can be hoped for in less than three months. In fact, many patients require four or five years to attain permanent arrest. For those dependent for their livelihood upon their own exertions, six to twelve months should be an average length of stay, but on discharge the patient should be frankly told that the next two years are the most dangerous for him. If he return to work, he must work and take care of himself, and he cannot usually play as well.

In some instances it is very difficult to decide when a patient should leave the sanatorium. As long as occasional attacks of fever, a persistently rapid pulse, and fatigue after slight exercise are present, the patient's position is insecure. When, however, the patient can work or take considerable exercise, no longer needs a forced diet to maintain his weight, has been apparently well for three or four months, he may safely consider returning to his home.

Insufficient treatment is a frequent cause of relapse.

Home Treatment.—The immense majority of all tuberculous patients have to be treated at home. At least 75 per cent. of those who seek

"sanatorium" or climatic treatment return to their homes long before the disease is permanently arrested. The treatment in many of the "open" health resorts is, for those who can afford it, treatment in their homes, and many of the objections against home treatment apply to this.

Treatment at home is less expensive, does not entail residence in a hotel or boarding-house or acclimatization after return to work; precludes separation from the family and friends, fatigue of travel, homesickness; does not break up business arrangements in the same degree, and in fact possesses every advantage, but change. A most important factor is the training of the family. When this is once accomplished the adjustment of the future life is more readily obtained, more consideration is afforded both by friends and by the family, and permanency of the results is better assured.

The home sanatorium established in a tenement house in New York City, under the auspices of the Society for Improving the Condition of the Poor, to which not only the patient but the whole family is admitted, has accomplished excellent results.

It requires more moral stamina to sit out alone in a damp, cloudy, foggy climate than to do so surrounded by pleasant companies in a bright climate. The care and worries of home life are never fully lost. The mother cannot neglect her children nor can a merchant calmly neglect his business. The anxiety produced by sickness cannot be avoided at home. A selfish, exacting family is an indication for a change of residence, and no patient who has long borne all the burden of the family should be allowed to remain at home. These disadvantages of home treatment are neither few nor slight, but once met and overcome, the permanency of the results is at least theoretically better.

When possible the patient should move to the healthiest locality in the region. A change to the country or at least into the suburbs for a year is advisable. The house should stand well back from the street and not too near the neighboring houses, should have a sunny exposure, and, if possible, be at an elevation of 300 to 700 feet. The neighborhood of factories, gas-houses, etc., should be avoided. A sunny room, 12 x 14 feet or larger, with a ceiling 10 feet high, lighted by electricity, heated with hot water or steam, with two windows, or a window and a door opening out on a sunny balcony protected on one side with glass on which the bed may be rolled, makes an ideal place. These conditions can rarely all be obtained, and many shifts must be made. A tent in the yard or on the roof, a bay window or even a well-ventilated room may have to suffice for a time. The problem of good food with the poor is more serious than that of fresh air. A few weeks' residence at a sanatorium or the services of a nurse well versed in the treatment of pulmonary tuberculosis for a few weeks is of much value.

Climatic Treatment.—The value of certain climates has been called into question and today rests largely upon personal belief and experience. Much has been written and little proved. There are localities differing widely in every climatic element in which man does well—why, we often cannot say. There is no specific climate for pulmonary tuberculosis, and

a good climate alone is of little avail. Without doubt many of the effects attributed to climate can be ascribed to change of climate. Change from a "good" to a "bad" climate often produces excellent results. It is rarely advisable for a patient to remain in any climate without change for more than eight or nine months.

The objects of climatic treatment are to furnish a complete change of environment, to withdraw the patient from the influences under which he contracted the disease, to subject him to a climate which will promote healing in the lungs, by increasing the activity of the digestive functions and thus stimulating nutrition, by improving the tone of the nervous and circulatory system, either by invigoration or protection, and by lessening exposure to secondary infections. Further climatic treatment may have for its object palliation of distressing symptoms in patients whose disease may not prove fatal for months.

The ideal place should possess purity of air, a dry, porous, salubrious soil, good water, good sewage disposal, relative protection from wind, and such a temperature that the patient can spend hours out-of-doors without discomfort. Abundant sunshine, infrequence of fogs, the persistence of snow throughout the winter, are all of value.

Wind has been described as an etiological factor in pulmonary tuberculosis, but its chief action is, no doubt, due to keeping the population indoors where with all crevices carefully closed the ventilation is poor. It greatly purifies the atmosphere, although in excessively dry climates it creates much dust. Forests and vegetation prevent dust, protect against wind, and render the climate slightly more equable.

Young persons usually meet high heat demands well, those past fifty years less certainly, while older individuals fail to meet them. Younger, fairly robust or robust patients, therefore, demand a climate of invigoration, which is cold, dry, variable (a diurnal variation of 20°) and more or less elevated, while older, more or less delicate persons need a climate of protection which is warm, moderately dry, equable, sheltered, and usually at much lower levels. Large eaters, often somnolent in summer, usually stand cold well. Patients susceptible to chilblains and to Raynaud's disease may do remarkably well in cold climates.

Symptoms have long been used as a guide in the choice of climate. The increase of cough and even of expectoration on change to a cold climate was advanced as an argument against cold but it has been recognized that the increased nutrition amply offsets this exacerbation of cough, which in patients suitable for such climates soon ceases. A dry climate is suitable for free secretion and a sea climate for scanty secretion in bronchitis, but the same does not necessarily hold in pulmonary tuberculosis (Lindsay). A tendency to hemoptysis need not be considered unless in a patient with extensive cavities, when high altitudes are contraindicated. Patients with chronic catarrh should avoid windy places (Weber); those with asthma should go to moderately elevated localities if young, to warm resorts with slight elevation if older.

Acute pulmonary tuberculosis is a contraindication to change of climate. A temperature of 99° to 100° F. in the morning, rising to 101° to 102° F. in the evening, precludes travelling. When the temperature falls to

J. S. Lobethal (P. H. Reports, Report 8 2 40 Sick

normal in the morning a change may be considered. Persistent tuberculous diarrhœa, extensive laryngeal invasion, pneumothorax, advanced nephritis, marked dyspnœa with cyanosis, cachexia, and grave diabetes are complications that usually contraindicate change of climate, although life in many cases may be prolonged and suffering alleviated by change from a colder to a warmer clime. It should never be advised unless the patient can obtain every comfort. In general, patients in acute stages should be kept at homes. Robust patients in subacute stages, or with chronic ulcerative disease within certain limitations, may be sent to any climate. Patients with advanced fibroid disease, delicate patients with subacute or chronic ulcerative disease, need a climate of protection, neither too cold not too high, but those in early stages will do well in almost any climate.

The mental characteristics, habits, and surroundings of the patient at home must be considered. The pecuniary condition is of much importance. No patient should seek health in an open resort without $250 or sufficient for a six months' residence besides his railroad fare. The opportunities for work at health resorts are slight, as the field is always overcrowded. The practice of sending patients to health resorts with the advice to live out-of-doors, to exercise freely, and to consult no physician is criminal. It is inexcusable to send patients to places of which the physician knows little or nothing in regard to the expense, the accommodations, or the medical fraternity. A few wise, frank words of good medical advice *on arrival* may prevent a serious relapse or fatal illness. Great caution should be exercised for the first two or three weeks in a new climate.

Deserts.—The chief characteristics of a desert climate may be said to be purity of air (considerable ozone), dryness, a maximum amount of sunshine (and of light), great but constant variations of temperature between day and night, and slight precipitation resulting in few cloudy days, lack of vegetation, and much dust. The best-known desert climate is that of Egypt. The oasis Biskra in Algeria has been recommended. The United States possesses the most varied desert climate with an elevation varying from sea level to 6000 feet in Arizona, New Mexico, Utah, Southern California, and Colorado.

Marine Climates.—A marine climate is characterized by purity of air, an equable temperature, high humidity, high barometric pressure, great luminosity, and complete absence of dust and bacteria. For the majority the marine climate may be said to be sedative as well as tonic. Sea bathing is not advisable, but douches and sponging with sea-water may be employed. Sea voyages were formerly much recommended, but have fallen, and for the majority of patients justly so, into disuse. The position of ship's surgeon for a tuberculous physician ought to be taken only under the most favorable conditions.

High Altitudes.—"High altitudes" may be said, at least for therapeutic purposes, to begin at 4000 feet elevation, while those above 7000 feet need little consideration. The characteristics of these are low barometric pressure with reduction of oxygen, purity of air, low humidity, much sunshine of great intensity, a soil usually dry and porous, and great

difference between the temperature in sunshine and shade. The effect of these factors upon the human organism has long been studied and the results are very variable and in many instances contradictory. The thorax in time becomes larger (1 to 3 inches) and more mobile, depending on age, and to some extent upon exercise. Nutrition is stimulated and the increased oxidation takes place at the cost of the carbohydrates, with a consequent lessening of the fatty tissue. The appetite and weight are usually increased. Marked nervousness at times results.

The pulse at first and for many months in some is quickened and the increase after exercise is more noticeable than at lower levels. At first palpitation may occur but the blood-pressure is little changed. An increase in the number of erythrocytes and of lymphocytes in the peripheral circulation takes place. During the first few weeks (usually three) at high levels the erythrocytes gradually decrease, but later a real increase has been noted.

The effect of high altitudes upon patients with pulmonary tuberculosis is difficult in many cases to foresee. Great caution in regard to rest, exercise, and food is necessary for some weeks. Medical advice on the arrival in a high altitude is of the utmost importance. Many patients after recovery return from high levels to low with no ill results, but some find they must reside permanently at a considerable elevation. A patient should return to a lower elevation if there be lack of improvement, cyanosis, and difficult with sleep or breathing (Bullock).

The indications for treatment in high altitudes are far from exact. The general condition is of great importance, and a constitution capable of some resistance and organs capable of increased nutritive and oxidizing work are necessary. If the conditions be not fulfilled, or if albuminuria, severe diabetes, pronounced emphysema, grave anemia or nervousness be present the patient should not seek health in high altitudes. Marked arteriosclerosis, cardiac dilatation (unless very slight), nervous derangements, persistent tachycardia, pronounced aortic or mitral regurgitation with or without pleural and pericardial adhesions, forbid this treatment.

The most famous resorts in high altitudes are the Alps and the Rocky Mountains. The Alps are colder, have much more snow, more precipitation, more vegetation, are more frequented by healthy individuals, but offer much less opportunity for future employment than the Rockies. The latter are more suitable for weaker patients, have more sunshine, more wind, and more dust. Suitable accommodations are less expensive in the Rockies. Smelting towns should be avoided.

Many health resorts lie at a moderate altitude (1000 to 3500 feet), and it is still unsettled at what elevation the physiological phenomena attributed to this factor are first apparent. They cannot be said to have any peculiarly characteristic climate, but vary according to their latitude, or to their proximity to sea or desert. The only feature they have in common may be said to be purity of atmosphere. The best known of these resorts in America are the Adirondack Mountains, the regions about Asheville, about Liberty (N. Y.), parts of Maine, the Muskoka region, St. Agathe, Quebec, etc.

Balneotherapy.—The effect of balneotherapy upon pulmonary tuberculosis has long been questioned. The climate of many of the spas, found of avail in this disease, is often mountainous and excellent, but the duration of the treatment, three to six weeks, is too short for such a chronic disease. The waters of saline springs are of value in the catarrh of quiescent, torpid, and anemic patients.

Postdischarge Treatment.—On the return to the active duties of life the patient should have made clear to him that the struggle is not over and will not be over for four or five years. On discharge from treatment he should be given a card which contains his proper weight for his height and age, the lowest limit of safety, lists of suitable occupations and sports, brief statements concerning hours of rest (in bed), sleeping out, the normal pulse and temperature range, etc.

For months he should exercise the greatest care and live as nearly as possible the life he has been pursuing. The cold sponges, ten to twelve hours in bed every night, strict avoidance of persons suffering from colds and influenza, working only in well-ventilated rooms, avoidance of dust, of cramped positions, of fatiguing occupations, especial care about the diet and bowels, are all matters of great importance. Eight to ten hours a day in the open and sleeping in a well-ventilated room are sufficient for most patients, but on return to work in rooms, more or less poorly ventilated, sleeping out becomes almost a *sine qua non* of continued good health. Many devices have been employed to approximate these ends. Many patients have been able to keep at work by remaining in bed from noon Saturday until Monday morning. A few patients find that permanent residence in a good climate is necessary to enable them to work. Whenever possible the full quota of work should not be attempted at first, but gradually attained. Light work indoors is better than heavy work out-of-doors, and easy work in a home climate is far better than severe work in a health resort. The agricultural colony should be closely associated with the sanatorium to achieve the best results. Patients who obtain work in sanatoria have their chances of survival increased by 25 per cent. (Barnes). The follow-up work of many dispensaries has been a great aid to returned patients engaged in work, who often require sheltered employment.

Symptomatic Treatment.—Fever.—This coincides in most cases with the treatment of the disease. Every patient should have fully explained to him the ordinary causes of fever, such as excitement and overexertion. He should, further, be told that slight coryza, simple angina, constipation, and diarrhœa may cause fluctuations in his temperature and that a subnormal temperature, when every other symptom is favorable, needs no treatment; that the indications for rest depend not upon the low morning, but upon the afternoon or highest temperature, and that the highest temperature of one day decides what he should do the next. If fever occurs during the menses the patient should remain at rest, or, better, in bed for the first day or two. A rise of the morning or minimum temperature, even if it does not exceed 99° F. (oral), indicates absolute rest, and if it reaches 99.5°, rest in bed for several days may prevent a long and stubborn attack. Patients especially prone to fever should

avoid heated discussions, and prolonged visits should not be allowed. Exciting games, many visitors, and exciting novels, writing many letters, or attempting to transact business should all be forbidden.

Rest.—This has long been adopted as the most efficient method of combating fever in pulmonary tuberculosis. In many instances rest can be enforced only when the patient remains in his room with wide-open windows. To employ rest properly, however, it should always be taken out-of-doors, and a small, well-sheltered porch upon which the bed can be wheeled from the bed-room is ideal. The amount of rest required varies directly with the degree and persistence of the fever. A slight rise of temperature in a patient previously afebrile should always be treated by rest in bed, out-of-doors if possible, when the temperature reaches 100° F. at any time of the day. A few days' rest in bed will usually suffice to bring the temperature down to normal, but the patient should not be allowed to get up until his temperature has been 99° or lower for three consecutive days. A rise to 99.5° (oral) would contra-indicate all exercise except dressing, although permission may in many cases be given to go to the table for meals. In a few patients the fever persists until they are put upon a "typhoid regime" and not permitted to feed themselves or go to the toilet. When the disease is apical, lying on the affected side may help to reduce the fever. In other cases collapse therapy or thoracoplasty may be considered.

In some cases it is impossible to get the temperature below 99.5° to 100° F. every afternoon, even after prolonged rest in bed. If such a patient becomes depressed, loses his appetite, has a poor digestion, begins to lose weight, and if sleeping out at night does not reduce the fever, he should be allowed to sit in a reclining chair on the balcony for half an hour each morning, but should not dress. If this does not raise the temperature the time may be increased, or he may get up in the morning for a short time. Some patients improve more rapidly under this treatment, and those with digestive trouble are often helped by it. Short walks or drives may assist greatly in the recovery. However, if the fever is continuous, great care should be exercised. All patients whose temperature reaches 101° F. or over should be kept in bed for weeks if necessary or until, after a consultation, all hope is abandoned.

The treatment of acute fever varies with its cause. If due to some non-tuberculous intercurrent disease the treatment usually accorded that disease should be followed, but only within certain limits. If possible the disease should be treated in the open air, and in any case the patient should be put out-of-doors as soon as possible and good ventilation insured while indoors.

Hydrotherapy.—This should be employed with great caution and carefully watched. No hydrotherapeutic measures should ever be employed which exhaust the patient, and as a rule only those which do not necessitate moving him should be frequently and continuously used. Sponges, at first with water at 98° and later, when more accustomed to them, with water as low as 50° or 40°, are often refreshing. A salt sponge in the evening, followed by an alcohol rub, refreshes the patient and frequently induces sleep. If the patient is weak, alcohol may be added to the salt-water and not used separately.

Sig. Lactoplex ℔ ½, Quinini 1.0, Hexamethylentetramin 2.0,
Aqua q.s. 200. M. D. S. Three times daily, p.c. m.

Dietetic.—The diet depends upon the cause of the fever and the state of the digestion. In acute fevers not due to the tuberculous process the diet should be fluid if the fever is high. The chief dependence should be placed upon milk, either plain or diluted. It may be well to restrict the diet for several days, notwithstanding some loss of weight.

In chronic fever, food should be pushed to the limit and solids given freely. Fever rarely abates while the patient is losing weight and the necessity of eating should be impressed upon him. Idiosyncrasies should be given due regard and the patient forced to eat nothing he has an antipathy for, with the exception of meat, eggs, and milk. In high fever and when little food is taken it should be given regularly during the night if the patient is awake. In all cases a glass of milk or an egg should be taken at night if the patient awakes. Fats and carbohydrates should be supplied plentifully.

Medicinal.—Antipyretics should not be used until the fever has persisted for some weeks and are of little avail unless the patient is at rest. In some cases when a rise of temperature just before a meal prevents the patient from eating, or a rise at night prevents sleep, a judicious use of antipyretics often helps the appetite and prevents the insomnia. The most satisfactory and the least depressing antipyretic is pyramidon. Two grains given in capsules, at 9, 10, and 11 A.M., are often sufficient. Five grains may be dissolved in a tumbler of water and sipped throughout the day. In some patients profuse sweating follows the exhibition of the drug in capsules, but is less likely to occur if taken gradually in the watery solution. Many other antipyretics have been used such as antipyrine, 3 gr. (0.2 gm.) q. 4 h.; acetyl-salicylic acid, 2.5 gr. (0.17 gm.) at 10.30 A.M. and 12 noon; and phenacetine.

A tablet compound of acetanilide, gr. 2 (0.13 gm.), camphor monobromate, gr. 0.5 (0.03 gm.), and caffeine citrate, gr. 0.5 (0.03 gm.), often reduces the temperature when given at 10.30 A.M. and 12 noon, and even when failing to do this may prevent the chills and sweats which often accompany it. The use of arsenic is said to prevent chills. The antistreptococcic serums have seemed to benefit few patients.

Cough.—*Prophylaxis.*—A patient with persistent cough should be warned against all overexertion, such as rapid and loud talking, laughing, singing, rapid walking, running, and hill-climbing. He should avoid all irritants, including very dry air, vapors, smoke, dust, and drinks. Tobacco may have to be forbidden. The patient should have fully explained to him that it is not necessary to raise the sputum from the lungs, for cilia are provided for that purpose, and every cough is an act of exertion and may injure the lungs. Cough often begets cough and a tendency repressed may mean escape from a violent attack. Rest in bed for several weeks is often the best treatment for persistent cough.

Holding the breath or complete silence may help. Change of position has often a marked effect, and a patient who while in bed cannot eat when he sits up, on account of cough, should assume this position for a longer or shorter period, one-half to one hour, before meals. Cough due to irritating nasal secretions, pleurisy or fever is relieved by appropriate treatment, *e. g.*, strapping the side or the use of an antipyretic.

Sips of cold water, an occasional bit of ice, sugar-water (irritating to some), a bit of orange or its juice or some form of lozenge may prove useful in some cases. Too free use of any lozenge may prove diastrous to stomach and teeth. Counter-irritation has long been employed. A blister or painting with tincture of iodine under the clavicle on the affected side may give some relief. Suitable dietetic treatment may greatly lessen the cough, and the effect of cod-liver oil is well known.

An effectual *morning cough* should never be checked, but may be aided by the use of a cup of hot water with or without a teaspoonful of brandy or 20 drops of the aromatic spirit of ammonia with or without 5 gr. each of sodium chloride and sodium bicarbonate. Hot milk may be used instead of water, either alone or with equal parts of coffee.

Night Cough.—Many patients who cough on change of position experience some trouble on lying down. Hot water or milk one-half hour before bedtime may lessen this. The bed should always be warm. An incessant cough that prevents sleep must be checked, for a time at least, at almost any cost, and when other measures, such as acetyl-salicylic acid, fail a sedative cough mixture should be used. The cross-binder may afford considerable relief and is worthy of trial.

The attacks of *paroxysmal cough* are often difficult, but most necessary to check. Absolute rest in bed may bring relief. A few crystals of menthol vaporized in a spoon over a match and inhaled, and the inhalation of a few drops of chloroform and various mixtures, may be tried. Morphine should not be given hypodermically; a few drops of laudanum upon the tongue may control the attack. The continual use of the respirator may help.

The *emetic cough* is serious. Rest in bed for a time and in all cases avoidance of exertion after meals, may be beneficial, but limiting the fluids, especially hot drinks, at meal-time, and taking hot water as advised for the morning cough half an hour before meals and coughing up the collected secretions before meals, is often sufficient. In some instances the odor or the taste of the sputum causes nausea or irritates the pharynx. Here, besides deodorizing inhalations, the pharynx may be painted with various solutions (antipyrine, 20 per cent.; cocaine, 5 per cent.; sodium bromide, 20 per cent., etc.). The wheezing so often complained of, especially at night, may be relieved by expectorants or by the use of belladonna, cannabis indica, or stramonium.

Intratracheal injections and inhalations are chiefly of use in the treatment of cough and expectoration. Injections of menthol, creosote, guaiacol, iodoform, oils of eucalyptus, thyme, and cinnamon in olive oil, have been used with success in cough uncontrollable by other methods, and seem at times to render the sputum more fluid. Yankauer's laryngeal medicator which enables a patient to introduce oily or watery solutions into his own trachea is a valuable aid.

Inhalations often markedly benefit the cough, especially when the irritation is in the larger bronchi. The oro-nasal respirator (Yeo), which can be worn continuously, is probably the best means of administering vapors. A croup kettle, the simple atomizer, or a tin vessel with a towel for a cone, answer for hot steam inhalations. The following simple formulæ may be tried:

Posture: M. Neild [illegible] Pt. in pyjamas [illegible]
lower ribs [illegible], Scapulae [illegible]
edge; [illegible]. Low tip [illegible]

Lozenge: Levotropin 0.4, Heebain 0.005, cocain 0.005, Sodium borate 0.01, menthol cryst. 0.01, sugar q.s. for lozenge. Sig.

Sprays.—Menthol (1 per cent.) and oil of pine (1 per cent.) in albolene, tannin (2 per cent.), or liquor ferri subsulphatis (10 to 20 per cent.) in water.

Inhalations.—Croup kettle, etc. Compound tincture of benzoin (1 to 128 of water), carbolic acid (2.5 per cent.) in water, or creosote, eucalyptus, oil of pine, or oil of turpentine.

Oro-nasal Respirator.—Equal parts of creosote and spirit of chloroform; eucalyptol and ol. pini sylvestris, āā ℥ij, spirit of chloroform or alcohol, to ℥j (10 to 20 gtt.); or fluidextract of conium, 1 to 3 minims in alcohol.

There are certain periods when the administration of *sedatives* seems to be the lesser of two evils, and many of the milder ones may be used for long periods. Cherry-laurel water, syrup of wild cherry, and hydrocyanic acid, usually in combination with other drugs, are of value. Chloroform, chloral, and the bromides may prove useful. Indian hemp, belladonna, hyoscyamus, gelsemium, aconite, have been advocated and may be carefully tried.

The routine administration of sedatives should be avoided if possible, as the respite from cough obtained by opiates is bought with a price. Morphine should be used only in the terminal stages unless all other sedatives fail to give relief. It should be administered by mouth as a powder, or in fluid until all hope is lost, then hypodermically. Of the opiates, codeine gr. ¼ (0.016 gm.), dionin gr. ¼ (0.016 gm.), and pantopon gr. ⅓ (0.025 gm.), are the best. The smallest possible dose should be given, and it is a good plan to change from one to another. Dover's powder (gr. v to xv), or a few drops of the deodorized tincture of opium, often help when codeine and its allies fail.

Expectoration.—*Exercise.*—When permissible, walking slowly on the level, up slight gradients, and up stairs, all aid expectoration materially. The exertion of dressing and undressing often facilitates it unnecessarily and undesirably. Simple respiratory exercises, between meals or while walking, such as slow inspiration and expiration, with concomitant movement of the arms up and down, may help in raising the sputum.

Position.—Change of position, inversion, elevation of foot of bed, etc, often greatly facilitate expectoration and should be more frequently employed. Massage of the chest may aid and helps the circulation.

Inhalations.—These often loosen the expectoration and are in some instances almost specific for the fetor. The steam moistens the air and when saturated with balsams or carbolic acid renders the sputum less tenacious. Inhalations of creosote under a tent, or of carbolic acid (2.5 per cent.) from a vaporizer or croup kettle, are very efficacious.

Medicinal.—The value of hot drinks is marked. The ammonium salts (chloride, gr. v to x [0.3 to 0.65 gm.]; carbonate, gr. ij [0.15 gm.]) or the aromatic spirit of ammonia are probably the best expectorants for general use. Squill and senega are of value. Ipecac, apomorphine, and pilocarpine are of less value. Citric acid or its sodium salt may be tried when other means fail. Potassium iodide, gr. v (0.3 gm.), and hydriodic acid in syrup are often helpful. Digitalis and camphor, when the heart is weak, are of value. To lessen expectoration and the cough,

creosote and its derivatives, are excellent. Dilute hydrochloric and sulphuric acids and atropine should be tried in distressing cases.

Hemoptysis.—When conscientiously put to trial no method of treatment, as yet suggested, is helpful in every case. The first duty is to calm the fears of the patient and his family. In an initial hemoptysis only a cursory examination (inspection and auscultation) of the front of the chest should be made until the patient is up and about.

The patient should assume at once a semirecumbent position with four pillows, which favors the gravitation of the blood to the limbs and facilitates expectoration. The room should be well ventilated and cool, and sufficient, but not too much, covering should be used. Talking should be forbidden, only the necessary attendants allowed in the room, and the cough repressed as much as possible. Small pieces of ice held in the mouth often aid in this but too much ice may upset the stomach. An ice-bag should be placed over the heart. Application of cold to the testicles has been suggested. In severe attacks the patient must be made to lie absolutely quiet, and not allowed even to feed himself.

The diet in slight or moderate hemoptysis should be non-stimulating and cold or warm (never hot). Fluids should be restricted, and all alcohol, tea, coffee, or chocolate forbidden for some days. Acids are very grateful to many patients and help quench the thirst, but citric acid is forbidden by some. The older method of giving 6 glasses of milk and 6 raw eggs has been replaced by a dry, general but limited diet. The patient should be both thirsty and hungry. In severe hemoptysis it is wise to restrict the fluids greatly and to place the patient for several days on a very limited diet.

To limit the volume of blood in the lesser circulation many methods have been employed. The skin vessels should be protected against cold, especially sudden cold, *e. g.*, such as changing sheets in a cold room. Ligatures can be applied to three limbs at a time and changed in rotation, one every twenty minutes. The pulse should not be obliterated and the ligatures should be loosened gradually and not left on too long.

To increase the resistance on the proximal side of the point of rupture would necessitate constriction of the pulmonary vessels. The walls of the bleeding vessel are always diseased, and it is futile to base any treatment upon producing any change in the diameter of the affected vessel. Adrenalin in slight, oozing hemoptyses by subcutaneous injection or under the tongue is held by some to be of value. Intratracheal injection (40 minims of a 1 to 1000 solution in $1\frac{1}{2}$ drams of water) may prove more effective. Pituitary extract (infundibular portion) may be of value injected into the muscles in doses of 2 cc. until the systolic blood-pressure rises to 150 mm., but in actual practice it has helped little.

The nitrites have long been used. Flick controlling his results by the accentuation of the second pulmonic sound uses the alcoholic extract of nitroglycerin in 0.5 to 1 drop doses every one-half hour when necessary. Francis Hare called attention to the value of amyl nitrite in hemoptysis, which, in doses sufficient to produce its physiological effects, is of marked benefit in some cases and should always be used at once. If it fails to

see Lore, Mr. Griffin + Bailey (JAMA 1924; 83; 929)
Sorry: appar., don't see nitroglycerin in lungs, as appar. evidence against. No change while set as nitroglyc. Don't see

act advantageously it should be discarded. Pearls of 3 or 5 drops may, if useful, be put safely into the hands of the patient.

Sodium nitrite lowers the systemic pressure, but the pressure in the pulmonic system does not vary directly with that in the radial artery. It is dangerous to lower the blood-pressure too much and unwise if beneficial not to lower it enough. Observation of the accentuation of the second pulmonic may be of value and the systolic blood-pressure should be taken every two hours and the doses ordered accordingly, aiming to keep the tension within certain limits. Practically, it is wise to administer codeine, gr. $\frac{1}{4}$ (0.016 gm.), or if the patient is very nervous morphine, gr. $\frac{1}{8}$ (0.008 gm.), hypodermically, and possibly with it sodium nitrite, gr. j (0.065 gm.). Sodium bromide may be given in full doses.

Hemoptysis frequently occurs in the early morning hours and the patient awakens spitting blood. This may be due to variations in the pulmonic pressure which when sudden are probably more dangerous than a steady high pressure. To prevent these variations as much as possible and to equalize the blood-pressure, it is well to give morphine hypodermically between midnight and 2 A.M.

Aconite has been suggested in hemoptysis, and its use may prove to be beneficial. It reduces the force of the heart and slows it. The administration of nauseants (apomorphine, tartar emetic, ipecac, antimony, etc.) for this purpose is hardly to be recommended, although the use of table salt, either a teaspoonful, or in a supersaturated solution with ice, is a favorite remedy of many patients.

Atropine in doses of gr. $\frac{1}{120}$ (0.0005 gm.) may be given hypodermically every four hours for a time in severe hemoptysis, or, if well borne previously, gr. $\frac{1}{60}$ (0.001 gm.). Weismayr, who believes it reduces the blood-pressure, has given it in doses of gr. $\frac{1}{25}$ (0.0025 gm.). Digitalis slows the heart and steadies it, and in some cases of prolonged or slight hemoptysis, due probably to congestion, seems to be of special value. Emetin hydrochloride, gr. $\frac{3}{4}$ (0.05 gm.) subcutaneously may aid.

Calcium salts have been suggested to increase the coagulability. In many hands they have not given any striking results but are an excellent placebo. Turpentine has been warmly recommended and dilute sulphuric acid is said to aid coagulation. Injections intravenously of 5 cc. of a 10 per cent. solution of sodium chloride are used. A similar use of calcium has been made. By far the best substance to shorten the coagulation time of the blood is fibrogen (Miller), which should be given hypodermically in doses of 1 cc. per 75 pounds of weight and repeated.

Limiting the movement of the chest has been advocated. Strapping the affected side and the use of sand-bags has been suggested, but it is by no means easy in all cases to detect the origin of the blood.

While the value of rest cannot be overexaggerated, *exercise* is not always highly injurious. Several observers have adopted, and with excellent results when prolonged rest was of no avail, carefully graded exercises for patients with slight, but persistent, hemoptysis.

If the sputum be merely blood-tinged, or slightly streaked, and if hemoptysis has never occurred before, the patient, if in a minimal

stage, should be cautioned against any exertion for a few days. Such an occurrence in an advanced stage demands rest in bed.

Narcotics.—Morphine, and less effectually codeine, help to produce absolute rest, quiet the circulation, check the cough, and so help in the formation of the thrombus, but their use is not without danger. This quieting effect may result in areas of bronchopneumonia due to retained blood and secretions. For excited patients with a bounding pulse that cannot be quieted by other means; for those with great fluctuations in the blood-pressure, and particularly in those cases in which hemoptysis recurs during the night or early morning hours, morphine is invaluable. When used it should be given hypodermically in doses of gr. $\frac{1}{8}$ (0.008 gm.) and in a few instances for one or two doses of gr. $\frac{1}{4}$ (0.016 gm.). It may occasionally be necessary to give it every four hours, but as a routine, codeine, gr. $\frac{1}{4}$ (0.016 gm.), should always be preferred unless it excites the patient. Inhalation of chloroform has been recommended.

The use of astringents cannot be upheld. The question of stimulation after hemoptysis frequently arises. Digitalis, strychnine, camphor and alcohol have been used. The latter should be sparingly given. A low blood-pressure is conducive to thrombosis. It is rare that any treatment for anemia is required. There is some prejudice against iron, which should, however, be freely used if necessary.

Complications.—The treatment of many complications must be modified, and it is unwise to aspirate a pleuritic effusion if the sputum be blood-tinged. In one patient suffering from hemoptysis appendectomy was successfully performed.

Surgical Treatment.—The excision of one or more ribs over a cavity, when persistent hemoptysis is present, has given little permanent relief, but the production of artificial pneumothorax should be tried in every case of prolonged or repeated severe hemoptysis. It is best used in the interval between the hemoptyses and in advanced cases the injections of gas should be small and frequent. Transfusion may aid.

Prophylaxis.—Patients who have had repeated hemoptyses should exercise with great caution, and all violent respiratory movements must be forbidden. Women who have premenstrual hemoptysis should remain in bed during this period, and if severe, temporary or permanent castration by roentgen-rays should be considered.

Night-sweats.—The hygiene of the skin should receive special attention. The patient should wear woollen night-robes and in cool weather sleep between blankets, but should carefully avoid too much covering, especially over the feet. When sweats occur in weak patients, nourishment should be frequently administered, especially at night whenever the patient is awake, and in some instances he should be aroused and food given two hours before the expected sweat. Two or 3 drams of brandy in the milk at bedtime is often better than plain milk. Sponging at bedtime with an ounce of toilet or table vinegar, or of eau de cologne, in a pint of water, or even with pure vinegar, is very effective in many cases. Combined with equal parts of alcohol (95 per cent.), the commercial formalin (40 per cent.) has been painted on the skin every day. Its application should never be intrusted to the patient. Various combina-

L. Deem (J A M A 1926, , 1946) Elastic abdominal belt 5 in wide encircling waist & covering epigastrium, rib & costal cartilage below sternum. Could tighten & loosen.

tions of formalin in powders have given some relief when dusted on the skin. Salicylic acid has been successful as a powder (salicylic acid, 3 parts; starch, 10 parts; talcum, 87 parts).

A cold compress to the entire chest worn all night, or an ice-bag applied to the abdomen for several hours in the evening, lessens the sweats in many patients who get relief in no other way. A grass mat under the sheet may aid.

Drug treatment should be used only when all other measures have failed. Camphoric acid, gr. xij (0.8 gm.) at bedtime, should be first tried and the cough treated if necessary. Barbital gr. v (0.35 gm.) or sodium chloride ʒj (4 gm.) at bedtime; aromatic sulphuric acid, ʒss (2 cc.) at bedtime, may be tried; but in many cases it is wise to use atropine, alone or in combination with a little morphine and a mineral acid.

Dyspnœa.—When complications are excluded there remain many distressing cases of dyspnœa, such as those caused by rapid extension of the disease and by mechanical factors. Patients with advancing fibrosis and small pulmonary capacity should be told of their limitations, which they should not exceed. If due to weakness or to great difficulty in raising the sputum, stimulants and expectorants may be used. Oxyphor (an alcoholic solution of oxycamphor), in doses of 10 drops on a little sugar every three or four hours, often affords great relief. There are patients to whom these measures afford no relief but who are markedly relieved by the use of morphine in very small quantities. It should be reserved for patients in the very last stages or for those acutely ill.

Tachycardia.—Rest in bed or on a reclining chair has a marked effect, and should be insisted upon in all early cases when the pulse is persistently above 100. Severe exercise, excitement, coffee, tobacco, alcohol, and indigestible food should be avoided. Carbohydrates and in some cases all food may have to be limited and milk omitted. If cardiac distress or palpitation occurs, an ice-bag over the heart is often sufficient. Bromides, valerian, chloroform, and menthol may be of service, but digitalis and caffeine are of little value.

Pain. *Pleuritic.*—The treatment consists chiefly of immobilizing the side and in counter-irritation. Acute pleurisy demands rest in bed, and the cough, when severe, should be checked. In acute attacks the side should be strapped with zinc oxide adhesive plaster. The straps (two or three in number) may be applied about the thorax during full expiration, reaching 2 or 3 inches beyond the midlines, front and back, or one or two straps, if the pleurisy is in the axilla, may extend entirely around the thorax. A canvas jacket made with stays and laces with straps reaching over the shoulders affords great relief to some patients. Corsets help some women. Artificial pneumothorax has been tried with complete success.

External Applications.—Heat or cold may be applied, the latter best in the form of an ice-bag. Liniments are often useful and mustard poultices, mustard plasters, or painting with tincture of iodine, are of value. It is wise to apply mustard or iodine to a number of small areas about the size of a postage stamp, leaving fully as large an area between

for future applications. Ointments containing menthol, belladonna, and opium may be rubbed in. The cautery, lightly applied, is superior to most applications. A blister under the clavicle may aid when the pleurisy is in this region. Cloths kept moist in a saturated solution of magnesium sulphate and applied for some hours may be helpful (Tucker).

Medicinal.—Sodium salicylate up to ℥iss (6 gm.) per diem if necessary, followed by smaller doses, gr. viiss (0.5 gm.) with or without potassium iodide, is held by some to be almost specific. Acetyl-salicylic acid, acetanilide, and phenacetin are helpful, and, finally, in a very few cases, morphine must be used.

Hyperesthesia.—Massage, local hydrotherapy, electricity; belladonna and opium plasters; iodine locally; ointments of veratrine, of chloral, cocaine, and menthol; and chloroform in oil may be used. Often the condition requires no treatment save encouragement.

Treatment of Complications.—This interferes little in many cases with the general treatment. As a rule it is easy to decide whether or not, for the time being, the outdoor life must be abandoned; if any doubt arises it is wise to treat, first, the pulmonary lesion. The patient if confined to bed should be in a room which opens on a porch upon which the bed may be moved.

Nose.—Obstructions should be removed as soon as the patient's condition warrants it. Tuberculous ulcers should be kept covered with vaseline and natural heliotherapy used.

Influenza, Coryza, Bronchitis.—The patient with influenza should be isolated and repeated attacks of coryza and bronchitis suggest the advisability of the use of vaccines made from cultures from the patient's sputum, or obtained in the form of the so-called "cold vaccines" (non-specific therapy). If fever be present, the patient should be in bed. In catarrhal conditions of the upper air passages the patient should remain indoors until the acute stage is over. For the intercurrent attacks of coryza, leading often to laryngitis, tracheitis, and bronchitis, a full hot bath (110° to 115° F.) at night, followed by a cold spray, the use of salol, of a mixture of liquor ammonii acetatis, ℥ij (8 cc.); paregoric, gtt. x (0.6 cc.); sweet spirit of nitre, ♏xv (1 cc.); and camphor-water, q. s. ad ℥j (30 cc.), every four hours, may abort the attack. For the succeeding bronchitis after the acute stage is passed, nothing is better than creosotal (♏v) after meals. The cold chest bath should be practised each morning throughout the attack. A drop of the tincture of aconite every hour for a few doses often aborts a cold.

Pleuritic Effusion.—Some advocate paracentesis as soon as effusion is diagnosed. It is often wise to replace the fluid with filtered air. Sweating, purging, calcium salts, and restriction of fluids may be tried in chronic cases.

Empyema.—The pus, if secondarily infected, should be removed by aspiration and gentian violet (1 to 1000) or acriflavine (1 to 2500) used for irrigation as often as necessary. It is unwise to incise the chest wall if tubercle bacilli are present. Extrapleural thoracoplasty may be resorted to later. Some cases, containing tubercle bacilli only, do remarkably well when left alone or tapped only when pressure symptoms arise.

4% iodine - salt H_2O compresses over night (Sonnenstein)

Journal of Am. Med. Assn.
Nov. 29, 1925, page 1761

Calcium Chlorid in Treatment of Exudative Pleurisy.

Thoné applied calcium chlorid in treatment of twenty-three patients with serofibrinous pleurisy. In 11 cases the fever subsided and the effusion disappeared in 3 to 6 days after beginning the treatment there had been no recurrence of fever or effusion. The improvement was slower in five other patients, and no effect was noted in four to whom the calcium chlorid was given on the eighth or tenth day of the disease. The best results were apparently obtained in tuberculous pleurisy. This treatment is based on the elimination of the sodium ions and subsequent dehydration, and their replacement by the calcium ions. Therefore the diet should be sodium-free so far as possible. A dose of 15 gm. of calcium chlorid is given the first day; if the fever persists, it is increased to 22

(watrow)

for future applications. Ointments containing menthol, belladonna, and opium may be rubbed in. The cautery, lightly applied, is superior to most applications. A blister under the clavicle may aid when the pleurisy is in this region. Cloths kept moist in a saturated solution of magnesium sulphate and applied for some hours may be helpful (Tucker).

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4% iodine - salt H_2O compresses over night (Sömmerlein)

gm. by the third day; ~~tfrtxa~~ and continued for two or three days. Otherwise, only 7.5 gm. is given the second day. Even the large doses were well tolerated. He adds that calcium chlorid treatment proved effectual also in Garcéano's two cases of tuberculous exudative peritonities.

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4% iodine - salt H_2O compresses over night (Sömmerlein)

Asthma: McBroom: Canad. Jr. 1927, 1426. 9 ounces whole
unstrained bl. directly by syringe, 500 to 600 cc.

Laryngx (Soc. Thompson & Trail: Lancet 1922, I 936) Verb. Pneumo. indicated in
all severe acute miliary. Adds cautery. Revel; endolaryng. in sev. tr.

Pertussis, prim: pneumothorax (Adle. inj. in interscapular region)

If valvular or fails to close inject 200 to 400 cc of 2% formalin in oil & repeat.

Pneumothorax.—This admits of little choice at first; later the treatment may be conservative or radical. Absolute rest in the reclining position, application of straps or hot flannels, morphine (with great caution) for the pain; the diffusible stimulants, ether, aromatic spirit of ammonia, digitalis or strophanthus if collapse set in, and amyl nitrite, should be tried when the symptoms are urgent. It may be necessary to relieve the tension at once, and, if the opening be valvular, West's method of leaving a needle *in situ*, from which a rubber tube runs into a vessel of sterile water, may be employed advantageously. As soon as is necessary air should be introduced in an attempt to keep the lung collapsed for some months. Mild purgation should be used after the first day. When effusion takes place quickly it seems undoubtedly wise to refrain from aspiration for several days, and then it should be removed with as little suction as possible and replaced by air. The siphonage method should be tried. The use of two needles and washing out the pleura with boric-acid solution Fowler finds helpful in many cases. The treatment suggested for empyema may be used if the bronchial communication has closed. Thoracotomy and even thoracoplasty may have to be resorted to, especially when pyopneumothorax supervenes.

Secondary Infections.—The results of antistreptococcic serum have not been satisfactory and the treatment is not entirely devoid of danger. A vaccine, made from organisms from washed sputum, may be of some help, especially in chronic stages with abundant sputum. Creosote and its derivatives are very effective in some cases. Inhalation of vapor from carbolic acid ($2\frac{1}{2}$ per cent. in water) for fifteen minutes night and morning, as well as of creosote, have been recommended.

Anemia.—In the majority of cases the hygienic-dietetic treatment is all that is required. Nothing is more efficacious than Blaud's mass with gr. $\frac{1}{6}$ (0.01 gm.) of the extract of nux vomica after meals.

Digestive Disturbance.—Every means should be used to determine the cause, which is usually intestinal tuberculosis or overfeeding. Lavage need not be feared except in case of a recent hemoptysis, and a test meal may be given safely but usually is of little help.

Prophylaxis.—Many patients have to be taught how to expectorate. Sputum when swallowed may cause a simple diarrhœa, almost impossible to control, or tuberculous enterocolitis.

Flatulence.—The treatment should be at first dietetic. All fluids at meals should be avoided unless at the very end. Milk may have to be modified or given up for a time and the diet restricted largely or wholly to albuminous food. Effervescing waters should be avoided.

Dilatation of the Stomach.—The fluids should be limited, the abdomen may be supported with straps, the patient should lie on the right side at intervals for one or two hours after meals, and finally recourse may be had to daily or semiweekly lavage.

Vomiting and Nausea.—It is wise for a few days to put the patient in bed, restrict the diet to peptonized milk, hot or iced, or feed per rectum. This with lavage is often sufficient. With dyspepsia the diet may have been too bulky, or fermentation and decomposition may have occurred, with subsequent irritation. Gastric sedatives are indicated. For

nausea, restriction of food, drop doses of the tincture of nux vomica every fifteen minutes, calcium chloride (5 to 10 cc. of 10 per cent. solutions) given intravenously, and other remedies for vomiting may be given.

Anorexia.—Rest out-of-doors is sufficient to restore a lost appetite in many patients who have been at work. If too prolonged rest has been followed, carefully regulated exercise is often helpful. All lunches between meals should be stopped and if the anorexia is pronounced the patient should be put to bed and fed on liquids. The most important factor is often a complete change of surroundings and of table. If fever be the cause, antipyretics may be used advantageously, especially pyramidon or acetyl-salicylic acid. Bitter tonics, a little Vichy, or a drop or two of creosote in water, or a little whisky or wine with the meal often aid. The false appetite, a desire for food until the first few mouthfuls are taken, when all appetite is lost and nausea may appear, may be benefited by nux vomica or dilute hydrocyanic acid before meals.

Constipation.—Every other means should be tried before drugs. The quantity of water, especially between meals, must be sufficient, and the patient should eat freely of fresh and preserved fruit. Massage of the abdomen relieves some. Glycerin suppositories and enemas of olive oil at bedtime may be effective. The large amount of food makes the condition of the bowels of great importance, and occasional doses of castor oil or of calomel and a saline, are in some cases a necessity and aid most patients.

Intestinal Tuberculosis.—An accurate method of diagnosis of early intestinal tuberculosis has made its early treatment possible. Heliotherapy, natural and artificial (ultra-violet ray), produces remarkable effects in some of these patients. Gradual exposures beginning at the feet and increasing in time often bring about a loss of most symptoms in one to three months but roentgen-ray studies show that the treatment should usually be continued for seven to ten months. The diarrhœa is relieved, and little or no dieting is required. The constipation, when present, is often lessened (relief of spasm). When the condition develops in advanced and very exhausted patients, the problem is difficult and little can be hoped for. Artificial buttermilk or calcium chloride intravenously, two or three injections of 5 to 10 cc. of a 5 to 10 per cent. solution at intervals of four or five days, may afford great relief and, indeed, in some cases all symptoms are lost. Paregoric relieves the pain and can be used freely. A capsule containing 2.5 grains (0.16 gm.) each of salol and Tully powder (Pulv. morphinae co.), three or four times a day relieves many patients, or opium suppositories or opium and starch enemata may be required. Turpentine stupes, hot or cold applications (ice bag), may be grateful. Any article of food that increases the diarrhœa and pain should be omitted. An abdominal band should be worn continuously.

Surgical measures have not proved very successful. Many patients stand resection badly and suffer more after short circuiting unless, as Brunner and later Archibald advise, a double mucous fistula is formed by bringing each end of the affected portion out through the abdominal wall.

Calcium - Some Comp. 1923-1944-5

Perianal Abscess and Fistula-in-ano.—Warm, moist applications should be applied until pus forms, when, under a local anesthetic, the abscess should be incised. In a few instances the abscess heals, but usually a fistula results, which, when the patient's condition warrants a general anesthetic, and when well defined by scar tissue, may be excised. Fistulæ can exist for years and exert little or no discernible influence upon the general health if carefully and frequently cleansed. The injection of mercurial ointment into, or of tuberculin about, them has in some cases resulted in healing. Natural heliotherapy may be helpful.

Arthritis.—Patients with pulmonary tuberculosis and arthritis do better in warm, equable climates. The salicylates are usually well borne, and oil of wintergreen may be applied.

Syphilis.—This need in no way interfere with the routine treatment. Mercury and arsphenamine are well borne.

Menstrual Disturbances.—Amenorrhœa is frequent, and, unless accompanied by some discomfort, requires no treatment. Many patients suffer considerably at this time, and rest in bed should be advised.

Pregnancy.—Conception should be avoided in all cases when the patient has not been well for at least two years. The dangers of repeated pregnancies should be carefully explained. Temporary castration by roentgen-rays may be considered. When pregnancy occurs, abortion should be considered if the pregnancy is in the first three or four months. Tuberculous laryngitis and nausea and vomiting in the early stages are positive indications for abortion, which should be performed by the quickest and least laborious method. At term labor may be allowed to proceed to the beginning of the second stage, when chloroform may be administered and forceps applied. The mother should not nurse the infant. It is often well to institute a short course of treatment after delivery in patients whose disease has been long cured.

Insomnia.—The patient should not sleep during the day. The room should be dark, well ventilated, not too cool (40° to 50° F.), and the bed warm. Some patients sleep much better out-of-doors. A wet pack to the abdomen, legs, calves, or feet, or a full chest pack may be efficacious. Massage of the back is often helpful. Fever may cause insomnia and the temperature should always be taken at night for a time when insomnia occurs.

Medicinal Treatment. The "antiseptic treatment," chemotherapy, based on the idea that it is possible to destroy the tubercle bacillus without harming the tissues may be perfected some day. The view that healthy contiguous parts may be protected in this way has never been proved either in pulmonary or localized surgical forms of tuberculosis. No medicinal substance has yet been found to neutralize the tuberculous poison.

Creosote and its Derivatives.—These have no action whatever upon the tuberculous process, but in some cases seem to act almost as a specific upon the accompanying bronchorrhœa and intercurrent simple bronchitis. Their action is no doubt due in part to a stimulating effect upon the bronchial mucous membrane during their excretion through it. Small doses only are necessary in most patients, and Sommerbrodt's dictum that

the larger the daily dose the better the results cannot be upheld. Drop doses of creosote act in some patients as an excellent tonic for a poorly secreting stomach, and explanation of the benefit of combining it in these quantities with cod-liver oil. Among the contraindications are a persistent taste of creosote, gastric irritation, and nephritis. The patient should be warned to stop it or any medicine if the slightest digestive disturbances occur. Only pure beechwood creosote should be used.

Arsenic.—This has been thought to exert a specific action in pulmonary tuberculosis and in some it stimulates nutrition remarkably.

A number of substances which increase the leukocytes have been employed, among which is cinnamic acid. The same effect has been noted in regard to tuberculin, but nucleic acid stands as the best example.

Various salts of calcium (lactate, chloride, carbonate, bicarbonate, phosphate, iodide) have been given by mouth or hypodermically, alone or in combination with creosote, tuberculin, etc. The use of silicic acid is probably of little or no aid.

Strychnine, gr. $\frac{1}{30}$ (0.002 gm.), is of value. It acts advantageously upon a jaded appetite and neurasthenia.

Alcohol.—This is a dangerous food and a symptomatic drug of considerable potential danger, but of value in some cases of pulmonary tuberculosis. In a few patients a cocktail or a tablespoonful of whisky with the first part of the meal may aid a flagging appetite or weak digestion. One glass of stout, of bitter ale, or of a good wine may do the same. A small amount of brandy or whisky in milk or sherry with egg is permissible if it enables patients to take these foods who otherwise could not. One glass of beer or ale at bedtime or a little whisky may relieve insomnia, but these are dangerous remedies. A few patients with slowly progressing, chronic disease may prolong their existence by a judicious, although rather free, use of spirits.

Specific Treatment.—Tuberculin.—Many observers believe that the majority of tuberculins used clinically are of equal value, but heat above 60° C. and chemical manipulation may injure bacterial vaccines. For this reason it would seem wisest to select those tuberculins which have been subjected to the least manipulation.

From theoretical considerations it would seem that the most rational tuberculins named in the order of the dates of their discovery are B. F., T. R.,[1] B. E., and a mixture of B. F. and B. E. B. F. contains the products of the tubercle bacilli disintegrating during the growth of the culture, as well as any unchanged products of the tubercle bacillus given off in its growth, and, while less toxic than O. T. and possibly to be preferred for this reason for febrile patients, it may possess some immunizing properties destroyed by the prolonged heating to which O. T. is subjected. B. E. possesses all the immunizing substances in the tubercle bacillus and is subjected to heat of only 60° C. An emulsion of B. E. and B. F. would seem to combine whatever immunizing properties exist in either the tubercle bacillus or the culture fluid. K. Spengler strongly advocates

[1] The following abbreviations for the tuberculins are used: O. T., Koch's original tuberculin; T. R., tuberculin residuum; B. E., bacillen emulsion; B. F., Deny's bouillon filtré. See Hamman and Wolman: Tuberculin in Diagnosis and Treatment, 1912.

Thioflavine suggested for expts. (See BJ 19 25, 11, 20 abst)

See Sovg, E.K., Intracellular chemical composition of [illegible] properties & the nature of the tw. reaction JAMA 1925, 85, 650

Tuberculin liniment: D. E. Gunter B. M. J. 1926 I 1083

Fibrosis imp.; less, better results from Tr. Hyperaemia - liveness no contraind. Little results in subcutaneous epergy in ostium. Test out sensations, Less 1% 0.01 Tr. albumose free diluted = 0.5 cc comp. camphor liniment Rub rules into upper arm. Double if no heal or title 0.1 cc Tr. Rub more slowly take 1 cc Tr rubbed in.

B. F. of bovine origin (his P. T. O.), believing it causes few reactions and better immunity in infections with the human strain of tubercle bacillus. B. E. in large doses may cause sterile abscesses. B. E. and T. R. cause more local reaction at the site of inoculation, but apparently little more frequent, though less readily controlled, general reactions than O. T. or B. F.

Many other tuberculins have been used and possibly are of equal value, viz., T. O., watery extract, Beraneck's tuberculin, and tuberculol. Apparently of less value may be mentioned Trudeau's and Hunter's modification B., tuberculocidin, antiphthisine, purified tuberculin, oxytuberculin, tuberculoplasmin, tuberculomucin, tebecin, partial antigens, dead tubercle bacilli (Petroff) and tuberculin from fowl and fish tubercle bacilli.

Tuberculin should be administered to patients who are afebrile and in a state of good nutrition. Many patients who have long followed the hygienic-dietetic treatment seem to reach a state in which no further improvement occurs. They no longer have fever, the bodily weight is above normal, but cough, expectoration, and physical signs persist, and tubercle bacilli are found in the sputum. These patients may be subjected to tuberculin treatment in hope that chronicity may be avoided. It is also indicated in early closed pulmonary tuberculosis, and many recommend its use in members of "phthisical families," who present no evidence of the disease. Children do well under its use.

Patients with persistent slight pyrexia, which rest does not affect, may lose it under tuberculin. If the temperature reaches 101° F. it is wise to begin with doses smaller than usual, to increase with the greatest caution, and to abandon the treatment if any stubborn intolerance is manifested. In such patients too much must not be expected from tuberculin. It is rarely wise to administer tuberculin to patients whose minimum temperature does not fall below 99° F. every day. In patients who have had frequent or repeated hemoptysis great care should be used.

As contraindications to tuberculin treatment may be mentioned: Rapid loss of flesh, malnutrition (so frequent in late stages), meningitis, acute miliary tuberculosis, nephritis (non-tuberculous), epilepsy, pronounced nervousness, and a persistent pulse-rate above 100. Results have been obtained in ambulant patients in minimal stages.

The advice to be given patients inquiring in regard to tuberculin treatment is of great importance. It should be frankly explained to them that tuberculin carefully given can produce no harm, but that it may be of little or no immediately apparent value.

The administration of tuberculin by ingestion, inhalation, inunction, or intratracheal or intravenous injection is not recommended.

Dosage and Interval—In the proper selection of the dose and of the interval between doses lies the key to the successful treatment. Tuberculin should be looked upon as a most powerful poison, capable of producing irreparable harm in ignorant or careless hands. The slightest departure from the ordinary course of events should be thoughtfully considered. The tolerance to the tuberculous toxin varies greatly

(from 1 to 10,000, Sahli) and apparently is independent of sex, of amount of pulmonary involvement, and of general physique.

The beginning dose should always be far below that expected to excite reaction. In febrile patients and in those who have been subjected to the tuberculin test it should be smaller than in others. In B. E., Koch's beginning dose of 0.0000025 gm.[1] should be reduced to 0.000001 gm. for afebrile and to 0.0000001 for febrile patients. This is also the dose of T. R. For B. F. or O. T., the usual beginning dose may be 0.0000005 or 0.000001 cc., though in a few, especially if febrile, it may be 0.0000001 or 0.00000001 cc.

The increase of the dose depends entirely upon the individual. The usual method is to make each solution ten times the strength of the preceding and to increase the dose as follows: 0.1, 0.12, 0.15, 0.18, 0.22, 0.26, 0.32, 0.38, 0.47, 0.56, 0.68, 0.86, 1 cc. or 0.1 of the next solution. In many afebrile cases alternate doses may be omitted. This will prevent the cumulative action or the hypersensibility produced by too large doses and is especially applicable in febrile patients.

The greatest care in increase should be exercised in giving tenths of a milligram of O. T. or hundredths or tenths of a milligram of B. E. or B. F., as reaction most frequently occur during these doses. Once past this point without reactions, they are much less likely to occur. A large percentage (43) of patients first reacted when taking some tenths of a milligram of B. E.

The effect of small, often-repeated doses of the various tuberculins has not been sufficiently studied, although the work of Loewenstein and his assistants suggests the danger of acquired intolerance by such a method. Wright has not noted any such tolerance with very small doses. The work of Hastings and of Kinghorn shows that, with increasing the large doses of O. T. and B. F., the negative phase of Wright does not occur, and, when it occurs, need not be considered.

It is best to administer tuberculin twice a week from the beginning, for in some cases a retarded reaction occurs. When larger doses are reached or greater susceptibility is manifested, intervals of one week or longer are often advisable. If an intermission of several weeks is required it is wise to decrease somewhat the following dose. The maximum dose in any patient varies with the individual. The relation of the size of the final dose to the benefit derived from the treatment has not been worked out. The extent of the pulmonary lesion or of the change in the physical signs bears no necessary relation to the tolerance, although with advancing disease or the onset of complications the tolerance is often decreased. In B. E. 5 mg. (solid substance) should not be exceeded, while in O. T. and B. F. 1 cc. is the usual maximum dose. The maximum dose is often repeated several times.

Tuberculin administered according to these directions rarely excites any reaction until the larger doses are reached, and even then O. T. and B. F. rarely cause reaction. When a patient has once been found to be tolerant of tuberculin the increase may be more rapid. This

[1] B. E. and T. R.: Doses always given in solid substance of tubercle bacilli in suspension.

tolerance may be determined more rapidly by injecting 0.000001 cc. intradermically and increasing the dose ten-fold until signs of marked cutaneous reaction appear. A reduced dose, usually one-tenth, should then be given subcutaneously and tolerance to large doses may be more quickly obtained. Some aim to avoid tolerance and to give a dose that just fails to produce a slight general reaction. Others inject the dose intravenously. The bacillen emulsion (B. E.) of Koch (a ½ per cent. emulsion of tubercle bacilli) may be measured similarly as B. F., *i. e.*, by ignoring the solid contents and by taking into account only the liquid contents. The beginning dose (0.000001 solid substance) is contained in 0.0002 cc. This can also be carried out with T. R. The schema of increase for B. F. may then be followed. In any case, no matter how tolerant the patient is, the first course should be extended over five months. This can be readily done by lengthening the interval between the doses or by increasing the dose more slowly. If at any time during the course of treatment another "brew" or a different lot of tuberculin be used, the dose should be reduced.

All physicians who are not thoroughly familiar with the technique should give it *most carefully* and, one might almost add, fearfully. The slowest increase should be sufficient for them, and the slightest departure from the usual course on the part of the patient should be seriously considered and the dose increased or decreased accordingly.

Duration of Treatment.—No patient should be given tuberculin who cannot follow this treatment for at least five months, although shorter courses seem to be of some benefit. In the more advanced stages a longer duration is required. In most patients the focus of disease is rarely in one stage of development, and hence the need for long-continued treatment. The second and following courses of tuberculin may be given at home by the patient's physician.

The hygienic-dietetic treatment should be faithfully followed throughout the treatment. Exercise should be curtailed on the day of injection, and on the following days it is wise, especially if there be any tendency toward reaction, to keep the patient at rest in his reclining chair. The temperature should be taken before rising, and at 12, 4 and 8 P.M., also at any time of the day if the patient feel indisposed; in addition the weight and any unusual symptoms should be noted. If the temperature reaches 100° F. for more than two hours, rest in bed should be enforced until the temperature falls to normal if the reaction be light, or for several days in cases of a severe reaction. The headache during reaction or pain at the site of injection is best treated with an ice-bag or cold applications. The majority of patients have some manifestations of a reaction at different times during the treatment, but it is not rare, with carefully adjusted doses, for patients to escape reaction. Failure to observe the slighter symptoms of intolerance is the explanation of many failures with tuberculin. It should never be given when a patient is suffering from a coryza, acute bronchitis, gastric disorder, and fatigue or, in fact, is feeling "out of sorts" from any cause.

In most patients there comes a period of increased susceptibility when an increase in dose, which before caused no disturbance, results in a

violent reaction. The same dose should be repeated many times if necessary, or the interval lengthened for a time. In most patients who have been subjected to the tuberculin test it is accentuated. By great care it can practically always be readily overcome.

At the *site of injection* slight redness, swelling, and soreness are not uncommon, occurring most frequently after B. E., less after O. T., and less still after B. F. Large doses of B. E. leave indurated areas, which should be avoided on future injections, for otherwise abscesses may arise. The reaction at the site of inoculation depends partly upon the volume of the dose, less upon the concentration, and chiefly upon the site, occurring least often in the subscapular region. If the symptoms are pronounced the same dose should be repeated. With a slight rise of temperature no tuberculin should be administered until the temperature has been normal or at the same level as before for two days. After a rise of temperature of 0.5° to 1° without other symptoms, the same dose at the usual interval should be given. If the temperature rise above 99.6° F. (in a patient with normal temperature) without other symptoms, the dose before the last should be given. With the same rise of temperature accompanied with symptoms, the next dose should be reduced to one-half to one-fifth of the last dose, or even less. When the temperature reaches 100.4° or over (rarely unaccompanied by symptoms) the dose should be similarly reduced and not given for at least a week. Tuberculin should never be given again until all symptoms produced by the last dose have completely subsided. If the symptoms were slight, an intermission of one normal day is sufficient; but if pronounced, at least three or four such days should intervene.

The pulse is often quickened and at times the patient may complain of tachycardia. Dyspnœa or a sense of oppression occurs in a number of cases, resulting from overdosage. The sputum, blood, and urine are of little aid in foretelling reaction or determining the dose. Rise of temperature is often absent when headache, pain in back or limbs, malaise, fatigue, loss of appetite, or weakness occurs.

If these symptoms occur separately and are only slightly pronounced, the same dose should be repeated. If any one is severe or if several are present the dose should be reduced. With severe reactions various rashes may occur and enlargement of the lymph glands (axillary). In this case the following dose should then be much reduced and given at interval of at least a week.

A continuous, even if slight, loss of weight, when below the normal, means cessation of treatment for a time. Care should be exercised if stimulation occur, for this is often succeeded by depression.

Symptoms of local pulmonary reaction are not often marked with carefully adjusted doses. The cough and expectoration not infrequently increase for a time and, unless severe, need not cause a reduction of the dose, although it may be wise to repeat the same dose several times. It is unwise to give tuberculin to a patient with acute pleuritic pain. No tuberculin should be given for two weeks after a hemoptysis of 5 to 10 cc. or more, and it is usually wise to reduce the succeeding dose.

The relation of the increase of physical signs to the dosage has not

Calmette's ~~B.C.G.~~ vaccination by mouth of living bovine T.B. attenuated by growth in bile medium (B C G) reduces the mortality of infants exposed to the mothers (open) from 25% to 17% or less
(See Pr Med 1926, July 17, P899

been fully worked out. Marked changes do not usually occur until large doses are reached, and even then are far from constant. It is a wise proceeding to repeat the same dose until marked evidence of increase of physical signs is no longer present. An increase of dose, however, during this time seems to do no harm.

This method of using tuberculin is based solely upon clinical experience, and the effect of any one dose cannot be accurately estimated. No practical method has been discovered by which the effect of each dose can be followed and the succeeding dose properly estimated. Many reactions can be avoided by careful clinical observation. The patients should be taught to record accurately any symptoms, however slight. Even the most pronounced neurasthenic patients, if given tuberculin, betray no increased nervousness on account of keeping such a record, and, at least in the writer's experience, often less.

Repeated Tuberculin Injections.—Tuberculin in sufficient doses causes a congestion of the tuberculous foci, long thought necessary for healing, although doubt has been thrown upon it by the work of Wright. The local (organ) reactions in patients with mixed infection following large doses may result in great harm. Large doses of tuberculin are said to cause increased fibrosis about the tuberculous foci and elsewhere.

Injection of tuberculin causes the formation in the serum of antituberculin bodies; B. E. causes marked increase of the agglutinins for tubercle bacilli. Arneth concluded that the blood picture becomes more nearly normal. Lupton and Brown found a slight increase in the leukocytes, which only in the rarest instances, however, reached 10,000 per c.mm. The sputum is increased at first and may be more purulent. Later it often decreases or ceases. Tubercle bacilli disappear more frequently from the sputum in treated patients.

The writer's notice has repeatedly been called to the fact that many patients, treated with tuberculin, deserving apparently a poor prognosis, have enjoyed freedom from febrile attacks and escaped complications, apparently more often than the non-treated patients.

Treatment with Bacteria.—Many living bacteria have been used in the treatment of tuberculosis. Human tubercle bacilli have been employed with marked success in cattle. The attenuated forms markedly prolong the life of guinea-pigs. The time may come when attenuated tubercle bacilli can be used in man; some now recommend and practise this method. Inoculations of acid-fast bacilli have little effect other than causing agglutination of tubercle bacilli. Many other bacteria have been used, but the results are unsatisfactory.

Dreyer's diaplyte vaccine has proved of little help, and so far Spahllinger's serum and vaccine have been so little used by well known experts that their value cannot be estimated. Vaccination with the secondary organisms has been used. The serous exudate of blisters has been used as a specific by Mangant, and others (Flick, etc.) have advocated the production of blisters, protecting them carefully in order to allow the contents to be reabsorbed.

Serotherapy and Organotherapy.—Antitoxic serums from animal or man have met with little success and the danger of anaphylaxis, though slight,

is real. The injection of normal serums has yielded no benefit. Extracts of lymphatic glands or the powdered glands have been given, but without success.

Hydrotherapy.—This helps in withstanding cold (hardening process), strengthens the heart, slows the pulse, increases the vasomotor tone (and so raises the blood-pressure), often aids the appetite and causes deeper breathing. Its effect upon the nutrition and secretion of the skin is marked. Great freedom from colds is enjoyed by many patients who follow these methods. Every patient should take daily, preferably on arising, a cold bath or a hot bath followed by a cold sponge. After drying, he should experience a glow. Should this not occur or if heart disease, aneurism, or marked arteriosclerosis be present, it is wise to abandon any vigorous hydropathic measures.

For patients who fail to react and for patients susceptible to cold, it is wise at the beginning to insist upon simple measures. The bath should be taken in a warm room (never below 55°). All cleansing should be done with warm water (100°), and the cold (40° to 60°) applied with a sponge to the neck, chest (front and back), and arms as quickly as possible and immediately dried. It may be necessary to begin with tepid water or to begin with sponging one arm, on the following day both arms, and so on until the body to the waist has been sponged. Alcohol rubs may have to be substituted for a time.

For more vigorous patients, especially those long accustomed to it, the instantaneous cold plunge (50° to 70°) may be permitted. Others prefer a cold shower or full cold sponge, standing in warm water. For many patients these are not advisable, especially in winter, unless the water is slightly heated. In some patients nervousness is increased by too cold baths. Twice each week every patient should take a warm (100° to 105° F.) cleansing bath, using soap freely.

Hydrotherapeutic measures directed against the fever have helped little in pulmonary tuberculosis. Every patient with fever and confined to bed should be given each night a brine bath (sea-salt ℥ss in water Oij), the temperature of which should be gradually lowered, but never so low that a reaction fails to follow. An alcohol rub may be given afterward.

The "Cross-binder" worn during the night may be of help in severe cough with tenacious sputum, for pain in the chest (pleurisy, etc.), for catarrhal conditions of the upper air passages, and for insomnia.

Electricity and Light.—Static electricity, and high-frequency currents are of little value. Roentgen-ray treatments are said to help those progressing favorably and to injure those doing badly. Natural and artificial heliotherapy is being more widely used but no evidence has been adduced to show that it benefits uncomplicated pulmonary tuberculosis.

Surgical Treatment.—The early excision of the tuberculous focus has been frequently discussed and several times attempted, once or twice successfully, but cannot be recommended.

The early calcification of the first costal cartilage, resulting in lessened movement and narrowed apical aperture, led to the suggestion that in early stages an artificial joint be produced by cutting through the first costal cartilage. It has met with little favor. Numerous observers

Some claim has been made for spleen subcutaneously (Boyle, Br. Med 1925, Sept 23, P1266)

Rules for Heliotherapy Br Med Jr. 1926, 1; 210

Diathermy? helpful pneumonia.

Dausmain (Lancet 192, 754) Excellent. Plea for varying stimuli, light-exposure. Each pt individually treated. Can easily overdose those who need tr., months. "Shock" of tr. = redness, & sun. rickets is due to dyet, not light.

Thoracoplasty demands a better contralateral lung
and advancing disease must not be present.

have advocated that the diseased lung should be put at rest, by strapping the chest, by the injection of air, simple or carbolized, filtered or unfiltered, or of nitrogen gas. The surgical treatment of tuberculous cavities has produced few favorable results. The excision of one or several ribs over a tuberculous cavity or of many ribs to produce collapse of the lung has been advocated for healing and for relief of symptoms. Cases suitable for extra-pleural thoracoplasty are those carefully selected for collapse therapy in which, on account of adhesions, it cannot be performed. Excellent results have been reported by Archibald, Lambert, Bull, etc. but the results in many cases are disappointing. Phrenicotomy is useful in some cases of artificial pneumothorax and of thoracoplasty.[1] Except in gangrene it is doubtful if pneumotomy is ever of much benefit.

Artificial Pneumothorax.—This adds another to the effective means of treatment of progressive pulmonary tuberculosis. The object of the treatment is to cause complete collapse of the most affected lung. This prevents movement of and entrance of air into the lung, as well as any oxygenation so that all blood in the lung, except from the bronchial artery, is venous. It reduces the blood content from one-third to one-half and slows the lymph stream. This helps in the encapsulation of the foci, increases the fibrous tissue in the walls of the vessels, bronchi, and septa, but apparently does not affect the healthy part of the lung or prevent its expansion and functioning after months of treatment. The aspiratory action of the thorax is interfered with and less blood supplied to the right side of the heart, in which practically no change occurs. In many cases slight lesions in the breathing lung seem to improve unless too great pressure is maintained in the pneumothorax or the mediastinum is displaced.

The ultimate results are difficult to determine. About 40 per cent. have complete collapse, but even for the remainder the treatment is at least temporarily helpful which may hold true even when no gas can be introduced. When the patients are carefully selected about one-half are more or less permanently benefited. But many pitfalls lie along their paths and slight intercurrent pulmonary affections may prove disastrous. Accidents are always imminent. Consistent carefulness is all important (Parfitt). The treatment is worthy of trial in suitable cases which have failed to improve under other methods and the permanency of the treatment is assured.

Method.—The apparatus can be extremely simple, consisting of two large bottles, one filled with gas, the other with a solution of boracic acid and connected with the first by a siphon (glass and rubber tubing). A water manometer, filled with boracic acid, colored with methylene blue, registering from +40 to −40 cm., is connected by a "Y" with the tube leading to the gas bottle and to the needle. A few pinch cocks and a box in which to transport it complete the apparatus (Fig. 15). The needle is shown in Fig. 16.

The site of injection should preferably be in the lower part of the chest and not too near the heart. When convenient the patient should be so

[1] See Alexander, *Am. Jour. Med. Sci.*, 1924.

placed that it will be the highest part of the thorax. Areas which possibly overlie adhesions should be avoided.

FIG. 15

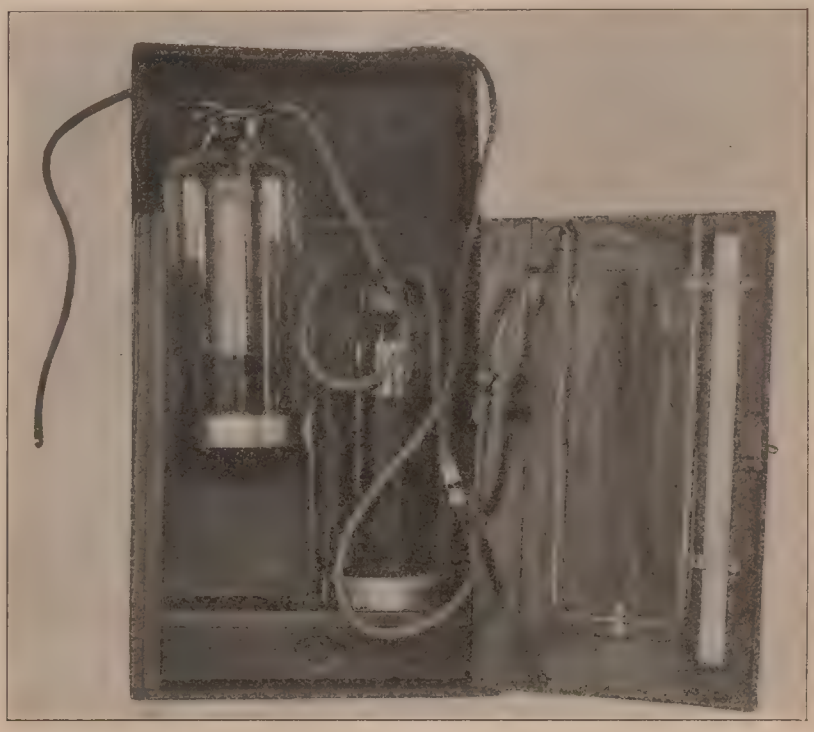
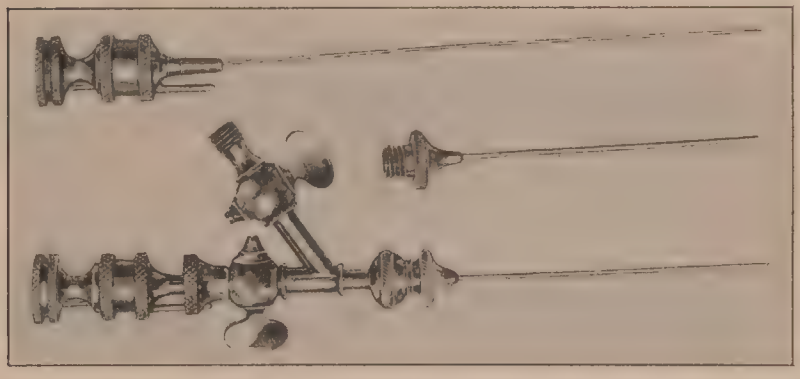


FIG. 16



Simple apparatus for injection of nitrogen into pleural cavity. Long manometric scale (−40 to +40 cm. H_2O). Floyd-Robinson needle with detachable shaft. Two sizes.

In nervous patients, it is wise to give morphine gr. $\frac{1}{4}$ (0.016 gm.) one-half hour before the injection. The area about the site should be painted with tincture of iodine and a solution of novocaine and adrenalin ($\frac{1}{3}$ gr.

Timothy or

Dwarfish: A. P. the opera. y choice for those who are [illegible] that
the race complexity for their cold.

and $\frac{1}{200}$ gr. respectively in about ℥iij or 15 cc. of boiled water) injected first into the skin and then into the muscles and pleura.

The needle is then inserted, and when it is thought to be through the pleura it is connected with the manometer. This is the critical point in the operation. If the needle is in the chest wall the manometer level is stationary, if it touch but not penetrate the parietal pleura a slight variation of 1 or 2 cm. may be obtained; if too deeply inserted, *i. e.*, into the lung, the pressure may vary from +1 to −2 cm. H_2O. If, however, it be in the pleural cavity, the pressure will vary from 0 or −1 to −5, to as low as −15 or −20, depending upon the adhesions (the more adhesions the higher the pressure). When a good negative pressure (−6 to −10) with a variation of 5 to 10 or more cm. of water is obtained, the gas may be safely allowed to flow in. Only 250 to 300 cc. of gas should be introduced at first, although many inject more. The second injection should be given the first or second day following the first, and from 250 to 300 cc. introduced. After three or four days the same amount cc. may be injected and from this time weekly, and later even only monthly, injections are required, as the pleura loses its power to absorb the gas. As a rule it is wise to inject air every two weeks but after several months of treatment refills should be done only when indicated by the fluoroscope which may also be used to control the dose. Barlow recommends very small doses of gas that collect over and allow the affected area to collapse. Few have used this method. It is wise not to raise the inspiratory pressure above 0 if possible, but when adhesions and only a partial collapse are present, a pressure of +10 to +20 cm. of water may be employed for a few minutes in order to separate the adhesions if possible, but it is never wise to leave a positive pressure over 5 to 10 cm. of water, and it is best to leave the pressure negative, especially if there is a weak or movable mediastinum detected by roentgen-rays. Change from the lateral to the dorsal position raises the pressure 2 to 4 cm.

The danger of injecting gas into the pulmonary vessels led some to to advocate an "open" method, which consists of laying bare, under local anesthesia, the parietal pleura and introducing a blunt cannula into the pleural sac. This may subject the patient to graver dangers than the "closed" method, which is to be preferred.

Gas.—Filtered air (80 per cent. nitrogen) is now generally used instead of pure nitrogen or oxygen.

Selection of Cases.—Artificial pneumothorax should be attempted in every case of severe pulmonary tuberculosis in which other treatment has failed and the lesion is practically limited to one side, except when complications are so severe that they alone will terminate life. Severe and repeated hemoptyses in the absence of pleuritic adhesions, may be quickly checked. The presence of adhesions is difficult to determine, but when the intercostal spaces are narrowed and fixed, when movement is limited, the ribs drawn in, or where by radiography the rib contour is indefinite, the intercostal space darkened and narrowed, when Litten's sign is absent, movement of the lower pulmonary border limited, when the percussion note is duller and the respiratory sounds weaker, adhesions

may be expected but are not always found. A long duration of the disease is no proof of the presence of adhesions. Even when adhesions are present and only a partial collapse can be attained, the symptomatic results may be gratifying. The occurrence of fibrous bands or strands which may contain pulmonary tissue is so frequent a cause of failure in collapse therapy that Jacobaeus devised a thoracoscope by which he inspects and often divides them with a cautery. The operation is difficult, may prove fatal, and opening and closing the chest is to be preferred in some cases. When the lung on the affected side is consolidated far less can be expected than when infiltration or even extensive excavation is present. The character and extent of the disease in the opposite side are of importance. Extensive infiltration may not prevent good results, provided dyspnœa is absent or very slight. An acute destructive process in both lungs is a contraindication. When, however, more than a third of the less affected lung is infiltrated the collapse should be very gradual. The time will yet come when it will be held justifiable to collapse the lung of a patient admitted in an early stage who steadily fails in spite of all other treatment, and this even though the disease has not advanced beyond one lobe. It can be given to infants and to pregnant women.

Complications.—These may be slight (subcutaneous emphysema), severe, or even fatal (gas emboli or pleural shock). Severe pain in the side with fever may occur, but effusion is far more common and occurs in 30 to 50 per cent. of the cases. It may become purulent (pus cocci or tubercle bacilli) and require treatment similar to tuberculous pyopneumothorax. When the effusion remains sterile it is wisest, if it is important to keep up the collapse, to replace it with air before the lung can expand and become adherent to the chest wall. Pleural reflex or pleural shock (a sickening pain in the side accompanied in severe cases by vomiting and loss of consciousness) can be usually avoided by careful cocainization of the pleura. Rupture of the lung may occur from too great pressure or from trauma from the needle.

Results.—The immediate results may be an increase of cough and expectoration with a rise of temperature, due to absorption of secretions that are shut up in the rapidly collapsed lung, which a gradual collapse may avoid. Loss of weight may occur for a time. In a few days when good collapse is obtained the cough and expectoration cease or wonderfully decrease, the temperature becomes normal, and more slowly the pulse falls to normal. These results are maintained at first only as long as the collapse is kept up, but sooner or later after two or more years, the lung may be allowed to expand, provided no symptoms arise. When extensive excavation has taken place it is wisest to keep up the collapse indefinitely.

In 600 cases (85 moderately, and 515 far advanced) 235 had satisfactory collapse, and 120 no free pleural space. Of the first group 114 are well, 44 arrested, and 52 dead. Of the last group 7 are well, 11 arrested, and 80 dead. Of the 245 with partial collapse 28 are well, 29 arrested and 142 dead (R. and R. Matson and Basaillon). Blanchet reports 200 cases of which 100 were advanced and 97 per cent. dead; and 100 moderately advanced of which 76 per cent. are alive.

Death due to occ in coronary arteries (Rubenstein & Scherlis JAMA 1928, 91, 1776).

Rettura & Crohn (JAMA 1928, 91, 1967) Jr. acute empyema complicated by bronch. fistula. Closed after closed artificial drainage

2-3 yr in early
3 yr. after.

at time, lung does not fully expand

(S.V. Pearson Brit. Med. Jr. 1926, 1, 52-3. Final results of G.P.

	of ca. practicable	not practicable
Able to work	29+4 = 42.3%	2
Dead	34+5 = 50%	9 (64.3%)
" Jr. other causes	1	—
Ill c the.	3	—
Lost sight of	2	3
	69+9 [9 not started by P]	14

Of 17 c fractures, 8 dead, 4 well pensioned, 1 ill, 4 unkn.
Of dead, lived 12 yr, 7" = 6, 5, 5, 4.

Accessories for Treatment.—The articles necessary for comfort while out-of-doors vary greatly according to climate, season, and individuality. As patients who undergo the outdoor treatment must live from six to ten or more hours in the open air, it is foolish to fit up a room luxuriously and neglect the porch, veranda, or wherever the patient passes his time out-of-doors. Few climates are so perfect that protection against wind, rain, snow, or sun need not be afforded. Revolving shelters, shack, huts, porches, roofs, fire-escapes, have all been used. The porch, preferably facing south in winter, north in summer, should be roomy, and well protected by a roof and glass screens on one or possibly two sides, but never on three. The depth should be little greater than the height of the roof in front. It should be well lighted by electricity. Awnings may be used during summer. When occupied by more than one patient it should be so spacious that the chairs or beds can be at least four feet apart.

A strong, comfortable, roomy, long, broad-armed chair, with a movable high back, provided with a good mattress and pillows with washable covers, and with a book rest or reading table, is a *sine qua non*. No chair is more comfortable than Dettweiler's, but the Adirondack Recliner is as comfortable and much more durable. Metal chairs last little longer and are very heavy. A light wooden chair with a canvas seat is very serviceable. Swinging chairs are less desirable, as the position is too readily changed. Hammocks constrict the shoulders.

In cold climates a fur coat, with a collar reaching above the ears, is a necessity, while fur rugs are more or less of a luxury. Steamer rugs are excellent, but horse or ordinary blankets and quilts answer every purpose. Sleeping bags are comfortable and should be made to come up to the armpits, front and back, opening in some cases down the front. Foot-muffs lend great protection to the feet. A small table for the sputum cup, bell, books, etc., is important. On exposed verandas windshields are necessary. Foot warmers should be avoided, if possible. Weak patients should never be allowed to wrap themselves up.

For Patients Confined to Bed.—The room, at least 10 x 12 feet, should have two windows, preferably in adjoining sides, reaching nearly to the ceiling (10 feet high). The waxed floors, preferably of hard wood, may be covered with linoleum. One or two rugs are advisable. All furniture should be well raised from the floor and, if upholstered, covered with leather or washable covers. Electric light and hot water or low pressure steam heating should be used. Coal-oil stoves should be avoided. Washable curtains, ending six inches above the floor, are not objectionable.

Opening out of one window which extends to the floor should be a porch, so arranged that the bed, wheeled out upon it, is fully protected from rain, wind, or snow. The bed should be of iron with a mattress of hair, air, or water. It should never occupy a corner nor stand with its head in a draught. A thin gauze screen in a window, which should not be closed, will often prevent a draught. A movable back-rest is important. A small bedside table for the cup, bell, urinal etc., and a bed-table are important.

For Patients Sleeping Out-of-doors.—When possible the bed should remain indoors until the patient is ready to retire, or, if possible, it should be heated with hot-water bottles, stone "pigs" or an electric pad. Two mattresses, one preferably a box mattress, with paper between them; three to five pairs of double blankets, with a mackintosh sheet over them (protection against rain, etc.), or with a fibre blanket between them; a lambs' wool quilt and flannel or outing flannel sheets are all useful. The pillows should be arranged in the form of a V, with the apex at the head of the bed to receive the head of the patient, or, better still, three pillows should be used, one extending down either side, parallel to the body, and a third for the head. Some patients prefer to tuck the covers under them and so form a sleeping bag. Such bags may be used. To make a "Klondike" bed, put all the covers, except the counterpane, on the bed but do not tuck them under the mattress. Fold them under on each side until they touch in the middle or lap, if a tight "Klondike" is desired. At the bottom, the covers can be either folded under and laid on top of the mattress, as is done with the sides, or tucked under the mattress. Over this envelope place the counterpane and tuck it in tightly all around the mattress to keep the envelope of sheets and blankets from slipping off the bed should the sleeper be restless. If the pillows are placed in an inverted V, protection from the wind is given the head and neck. To get into such a bed, one must slide in from the top. On very cold nights it is wise to cover the pillow or bed-clothes with a half-dozen small flannel squares, which can be removed one at a time when the breath freezes upon it, and to cover the face with cold cream or vaseline. Woollen or outing flannel night garments, a cardigan jacket, sweater, or bath robe, a woollen hood covering the ears and extending down under the jacket, a domino mask (lined with flannel), bed-slippers, "boots" of flannel, may all be used.

Euthanasia.—When, after consultation with one or more physicians, it has been decided that all hope for recovery is past, and that some time may elapse before death, it is in many cases kinder not to relax apparently any efforts toward overcoming the disease, but after some slight opposition, if need be, to acquiesce to the patient's wishes. Care should be exercised not to begin the hypodermic injection of morphine too soon, for fear it may lose its effect. Small doses (gr. $\frac{1}{16}$) night and morning lessen dyspnœa, check cough, and greatly improve the general comfort of the patient. The dose should be slowly increased. Inhalations of oxygen often give great relief and should be used for trying dyspnœa.

Results.—The results in general are encouraging. In the mind of the laity the former pessimistic view is replaced by the belief that every case of tuberculosis is curable. It is an easy task so to improve the general condition of a patient as to give him the outward appearances of health, but it is a far different task to get him into such a condition that after a few months at work he will not relapse.

Pulmonary tuberculosis is a relapsing disease. The results must therefore be considered under two heads, immediate and ultimate. The immediate results may be manipulated, even unconsciously, but the test of time is rigorous, and "living" and "dead" admit of no personal equation or variation of definition.

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Classification.—Patients must be classified on admission, on discharge, and according to the ultimate results. A classification should take into account not only the amount of disease in the lungs, but the actual condition of the patient. It must consider symptoms as well as the pathological and general conditions, for no one alone is sufficient. The personal equation should be eliminated as far as possible. The divisions, or classes, should be as sharply separated as possible and not too numerous, three being the number most widely advocated for many years. Prognosis and classification are closely associated.

Turban classifies patients wholly upon the physical findings. By this classification, Stage I includes those patients whose slight lesion does not exceed one lobe or two half-lobes. Stage II includes those whose slight lesion extends farther than Stage I, but at most to two lobes or a severe lesion extending at most to the volume of one lobe. Under Stage III are all not under I and II. "Slight lesion" is synonymous with infiltration and "severe lesion" with consolidation and excavation. Purely pleuritic dulness of slight extent is left out of account. Slight alterations in the breath sounds, without change in percussion and without rales, are not to be considered. This properly balances both the extent and the intensity of the pathological changes, two factors, one of which is ignored in most anatomical classifications.

The best classification is that adopted by the American Sanatorium Association and is as follows:

1. **On Admission.**—These definitions indicate the farthest extent of disease and the greatest severity of symptoms that a patient can present and still belong to the stage or substage defined. All patients beyond the minimal stage fall under the moderately advanced stage unless the physical signs and roentgen-ray findings exceed those of the moderately advanced stage, when they should be classified as far advanced.

Minimal (*Incipient*).—Slight lesion limited to a small part of one or both lungs. No serious tuberculous complications.

Moderately Advanced.—A lesion of one or both lungs, more widely distributed than under Minimal, the extent of which may vary, according to the severity of the disease, from the equivalent of one-third the volume of one lung to the equivalent of the volume of an entire lung with little or no evidence of cavity formation. No serious tuberculous complications.

Far Advanced.—Any lesion more extensive than under Moderately Advanced. Or definite evidence of marked cavity formation. Or serious tuberculous complications.

Subdivision by Symptoms.—Each of the above groups is further divided into the following substages according to the severity of the symptoms:

A. Slight or no constitutional symptoms, including particularly gastric or intestinal disturbance or rapid loss of weight; slight or no fever, or acceleration of pulse at any time during the twenty-four hours. Expectoration usually small in amount or absent. Tubercle bacilli may be present or absent.

B.—(Moderate).—No marked impairment of function, either local or constitutional.

C. (Severe).—Marked impairment of function, local or constitutional.

2. **On Discharge.**—*Apparently Arrested.*—All constitutional symptoms and expectoration with bacilli absent for a period of three months; the physical signs to be those of a healed lesion.

Quiescent.—Absence of all constitutional symptoms; expectoration and bacilli may or may not be present; physical signs stationary or retrogressive; these conditions to have existed for at least two months.[1]

Improved.—Constitutional symptoms lessened or entirely absent; physical signs improved or unchanged; cough and expectoration with bacilli usually present.

Unimproved or Progressive.—All essential symptoms and signs unabated or increased.

Dead.

3. **Ultimate Results.**—*Apparently Cured.*—All constitutional symptoms and expectoration with bacilli absent for a period of two years under ordinary conditions of life.

Well.—Patients who fulfil all the conditions required under "cured" but about whose sputum no definite information can be obtained.

Arrested. Improved. Progressive.—See above.

Dead.

Much opposition has been shown to the use of "cure," and many hold that while pulmonary tuberculosis is curable it is impossible to say when a "cure" is attained, and that to apply it, however modified, to patients is to give them a false sense of security. The use of tuberculin as a test of arrest has been suggested. The results obtained by it and by clinical methods do not agree, as many patients clinically "arrested" react to tuberculin. Nagel discharged 114 of 183 patients as clinically cured, and of these 114 patients, 38 per cent. reacted to tuberculin. Careful clinical observation determines sufficiently accurately whether or not a patient is arrested. More recently attempts to divide these cases into exudative and proliferative or productive type have been made. The two types may occur together or pass from one into the other.

Ultimate Results.—The real test is the division of all patients into two classes—living and dead. The division of the first class is difficult. Here ability to work is of most value, for it is difficult to obtain a physician's report on the general or pulmonary condition or on the sputum examination. An absolute cure can be determined only after death. At the Trudeau Sanatorium it is impossible to use this term "cured," for sufficient information cannot be obtained, and "well" has been substituted.

Statistical Reports.—The best statistical report is the one suggested by Turban, with the modifications adopted by the National Association. These consist in giving the side or sides of the lesion, full data on discharge as well as on admission, and the figures for temperature, pulse, and respiration, instead of symbols. To collect statistics which will be of value, the Association suggested that each sanatorium publish in its annual report the tabulation for each patient.

[1] The length of time is somewhat arbitrary, but is intended to cover cases in which the patients leave a sanatorium, contrary to advice, after a stay of a few weeks, although all active symptoms may have ceased completely soon after entrance.

Results of Dispensary Treatment.—These are difficult to estimate. Many of the patients in early stages are sent to sanatoriums, some in more advanced stages go to hospitals, and the majority who undergo treatment are under more or less unfavorable surroundings.

Results in Sanatoriums.—The results of modern treatment are necessarily based upon the results obtained in sanatoriums, for results obtained outside of these institutions are seldom if ever given in sufficient detail to be of value. The time of residence in the sanatorium is of much importance for the result.

Results at the Trudeau Sanatorium.—A study of the results obtained shows at once the great value of early diagnosis in both immediate and ultimate results (*i. e.* after one to thirty-nine years). Although the patients in the minimal stage were less than 21 per cent. of the total number, yet they furnished 66 per cent. of those apparently arrested on discharge. Of patients in the minimal stage 21 per cent. are dead, while of those in the moderately advanced 43 per cent. and of those far advanced 73 per cent. are dead. Of the patients in the minimal stage discharged with active disease (*i. e.*, neither apparently arrested nor quiescent) two and a half times as many recover, twice as many are alive, and only one-half as many are dead as those discharged with active disease in the moderately advanced stage. On the whole, the death-rate for the arrested patients may be said to be double the general death-rate. For patients discharged with quiescent disease the death-rate may be said to be eight time the general death-rate.

The patients who were neither arrested nor quiescent on discharge may be said to have on the whole a death-rate twenty-eight times the general death-rate. Roughly, over 50 per cent. of the patients in the minimal stage are alive fifteen years after discharge, while about 50 per cent. of those with moderately advanced disease are dead in six years. The classification by condition on discharge shows even a more striking picture. The ultimate results in those discharged arrested approximate rather closely the normal death-rate curve. The results in those discharged with quiescent disease are far less encouraging. In six years over 50 per cent. are dead. As the basis for classification changes these figures of course vary. It has been estimated that the monetary loss from tuberculosis is at least $250 per inhabitant of the United States or 26.5 billions of dollars or over 500 millions annually (Dublin and Whitney), and that adequate prevention would save over 400 millions annually (Emerson).

Loss of Physical Signs.—In a few rare instances not only the physical signs but also all abnormal roentgen-ray changes disappear, which Gardner's work on experimental tuberculosis shows can occur.

Weight.—The effect of sanatorium treatment upon the weight is shown in a study of 901 patients (453 males, 448 females) at the Trudeau Sanatorium. The weight of the men on arrival was 90 per cent. of their standard weight, that of women 91 per cent.; on discharge the men weighed 99 per cent. and the women 102 per cent. of this standard weight. Their usual weight in health was for the men 94 per cent. and for the women 95 per cent. of the true normal.

Children.—The results of sanatorium treatment in children are excellent. The figures show that children in minimal and moderately advanced stages do far better than adults, while those in far-advanced stages do worse (a matter of slight importance).

Results of Tuberculin Treatment.—No scientific basis for the very optimistic view of the tuberculin treatment that was formerly held can be found in the vast majority of the results so far published. The figures seemed to indicate that tuberculin treatment was of some value and the vast majority who have used this treatment are in favor of it, while admitting in some instances the discrepancy between their opinions and their figures. Few published statistics escape the error of selection.

Results of Tuberculin Treatment at the Trudeau Sanatorium.—A study of 185 patients treated with tuberculin and 864 not so treated all of whom stayed over ninety days and had tubercle bacilli in their sputum on admission, shows for the minimal stage a slight difference on discharge in favor of the treated patients. For the moderately advanced stage a very marked difference on discharge in favor of the treated patients was observed (arrested, treated 27 per cent., untreated 6 per cent.; disease quiescent: treated 50 per cent., untreated 51 per cent.; active, treated 18 per cent., untreated 43 per cent.).

The ultimate results from one to fifteen years after discharge in 135 patients treated and 690 untreated, all of whom stayed over ninety days and had tubercle bacilli in their sputum, show that of 100 patients in the minimal stage treated with tuberculin 79 are alive, of the untreated 63 are alive, while in the advanced stage 61 of the treated patients are alive and 36 of the untreated.

Loss of Tubercle Bacilli. Of all patients with tubercle bacilli in their sputum who undergo sanatorium treatment, only about 42 per cent. lose them. Any factor that can increase this figure is of great importance. Unquestionably the percentage of patients who lose their bacilli is larger among those treated with tuberculin. The disappearance of tubercle bacilli from the sputum depends directly upon the length of sanatorium residence. Tuberculin treatment can rarely be completed under five months, and in most institutions the patients receiving tuberculin remain on the average longer than the untreated.

Notwithstanding such results it has, however, been very largely abandoned in America, though still used somewhat in England and elsewhere.

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